March 1994 Issue #31

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Radio Fun

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"The beginner's guide to the exciting world of amateur radio."

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Important Message for Our Subscribers

The more perceptive members of the *Radio Fun* audience may have noticed that this issue is dated March 1994. This may have led you to thinking, "Hmmm, why didn't I get a February issue?" The reason is that there was (is) no February issue! Pull out your January issue and note the issue number. It's number 30. Now take a look at the top of this page. The issue number is 31. You haven't missed anything!

I suppose you want an explanation for why we've canceled February. As many of you have let us know, you don't like having your issue arrive bearing the current month's date. Because of the way we mail *Radio Fun,* many subscribers end up getting their issue in the third or fourth week of the issue month. Since we can't do anything about the Postal Service, we decided to just skip a month to sorta' "catch up." From now on, we'll be able to get all subscribers their copy of *Radio Fun* long before the calendar month.

Subscribers can rest assured that all subscriptions will be extended one month to make sure everyone gets 12 issues.

Novice Operators Gain Privileges

The Federal Communications Commission in late November decided to grant full 1.25 meter band access to Novices. The FCC declined, however, to adopt proposed rules that would have allowed Novice Class operators to own and operate repeaters in the 1.25 meter and 23 centimeter bands.

In other action, the commission adopted rules to create a small subband from 222.00 to 222.15 MHz for experimental work where repeaters are prohibited. Many experimenters feel weak signal work and repeaters are incompatible because of the lengthy operating time of repeaters. Under the new rules, all other types of communication can continue in this subband. This should allow for more weak signal experimentation.

Effective February 1, 1994, the following will replace the existing amateur service rules:

Section 97.201 Auxiliary Station

(b) An auxiliary station may transmit only on the 1.25m and shorter wavelength frequency bands, except the 222-222.15 MHz, 431-433 MHz, and 435-438 MHz segments.

Section 97.205 Repeater Station

(b) A repeater may receive and transmit only on the 10m and shorter wavelength bands except the 28.0-29.5 MHz, 50-51 MHz, 144-144.5 MHz, 145.5-146 MHz, 222-222.15 MHz, 431-433 MHz, and 435-438 MHz segments.

The entry under VHF in Section 97.301 (f) is amended by revising the frequencies authorized for use by Novice Class Operators in ITU Region 2 to read as follows:

Section 97.301 Authorized Frequency Bands

(f) For a station having a control operator holding a Novice Class operator license: VHF 1.25 m wavelength band: 222-225 MHz. Sharing requirements; see Section 97.303 paragraph (a).

More than 100,000 amateurs now hold the Novice Class License. *TNX W5YI Report, Issue #24, December 15, 1993.*

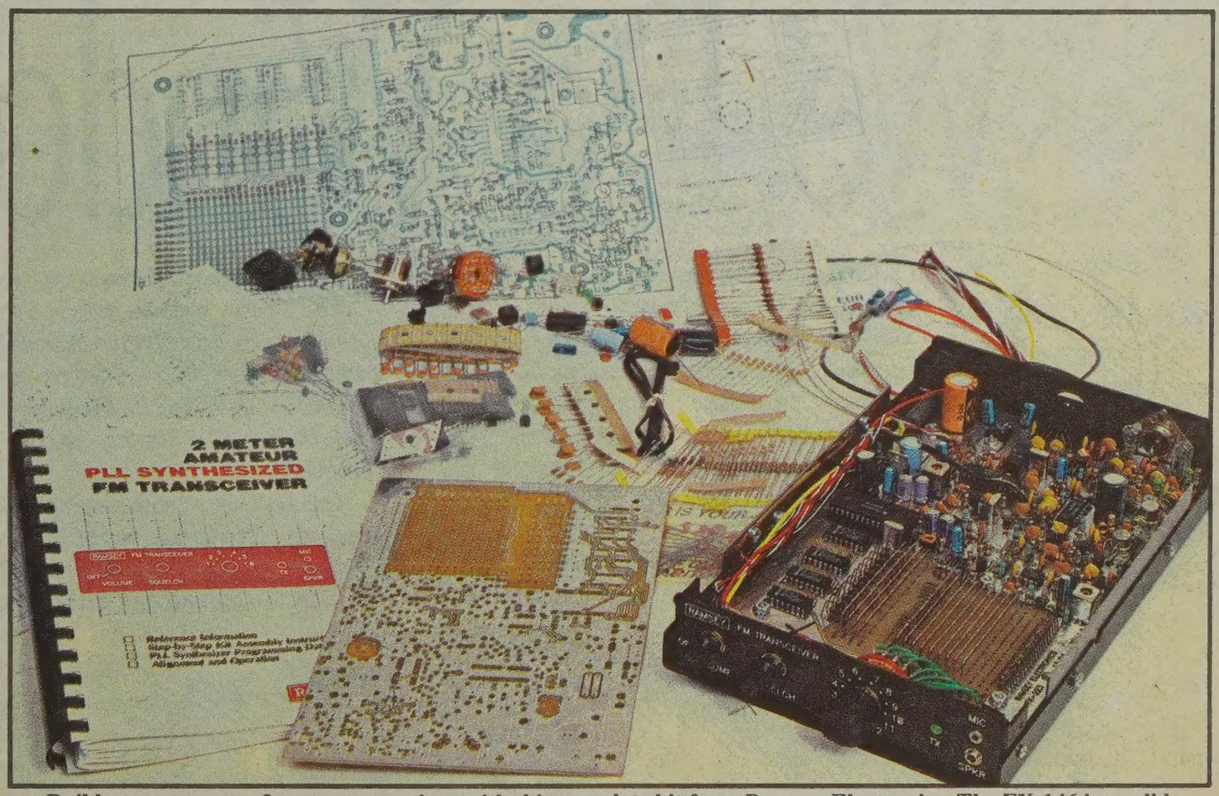
Form 610 is New

A totally new FCC Form 610 is on its way into ham radio as a result of a new computer at the Federal Communications Commission. The venerable old 610 will soon fade into history as a result.

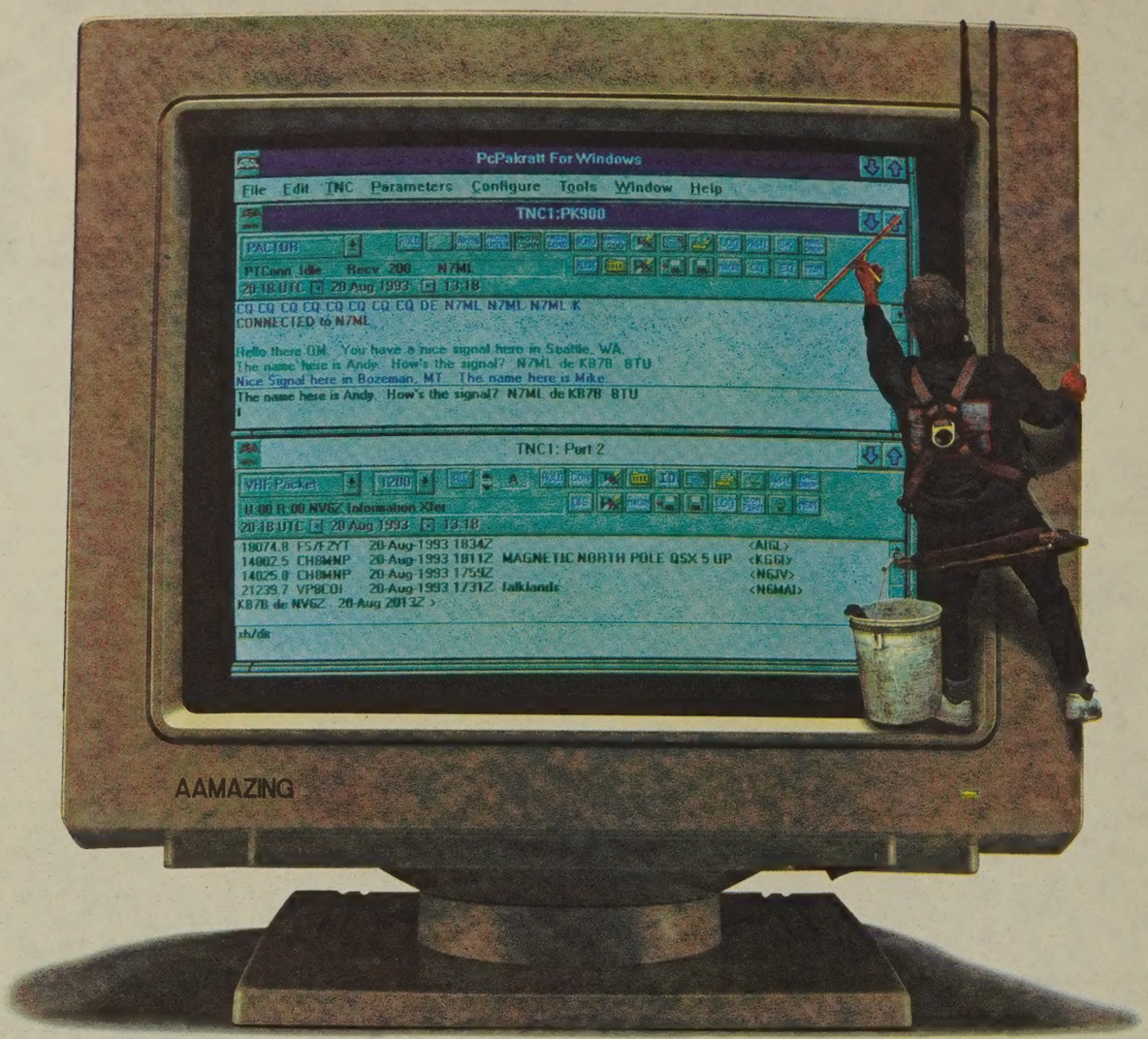
The new form is streamlined. It does away with all of the boxes previously contained in the administering VE's report. The report itself has been relocated to the bottom front of the form, right above the VE certification area. The administering VE will now only need to indicate which one of six classes the applicant is qualified for. The sixth category is "Technician Plus" and its inclusion on the new form indicates the commission wants to carefully track the popularity of this category.

Sections to report current station location and change of station have been eliminated. The new 610 still has a Physician's Certificate of Disability for those exempt from the code tests due to physical disability. This new form replaces the March 1992 version which carries a February 1995 expiration date, but which can no longer be used once the new form is in the hands of the public. *TNX Westlink Report, No. 662, November 26, 1993; Newsline; and W5YI-VEC.*

Roll Your Own Transceiver



Build your very own 2 meter transceiver with this complete kit from Ramsey Electronics. The FX-146 is a solid 12-channel synthesized FM rig that will teach you about electronics while you hand-craft a piece of gear you can be proud of. For the whole story, please turn to page 4.


PcPakratt For Windows
File Edit TNC Parameters Configure Tools Window Help
TNC1:PK900
PACTOR
PTConn Idle Recv 200 N7ML
20 18 UTC 20 Aug 1993 13:18
CQ CQ CQ CQ CQ CQ CQ CQ DE N7ML N7ML N7ML K
CONNECTED to N7ML
Hello there OM. You have a nice signal here in Seattle, WA.
The name here is Andy. How's the signal? N7ML de KB7B 8TU
Nice Signal here in Bozeman, MT. The name here is Mike.
The name here is Andy. How's the signal? N7ML de KB7B 8TU
TNC1: Port 2
VHF Packet
20 18 UTC 20 Aug 1993 13:18
18074.8 FS/F2YT 20-Aug-1993 1834Z <AI6L>
14092.5 CH8MNP 20-Aug-1993 1811Z MAGNETIC NORTH POLE QSX 5 UP <K6GI>
14025.0 CH8MNP 20-Aug-1993 1759Z <N6JV>
21239.7 VP8CDI 20-Aug-1993 1731Z falklands <N6MAI>
KB7B de NV6Z 20-Aug 2013Z >
sh/dx
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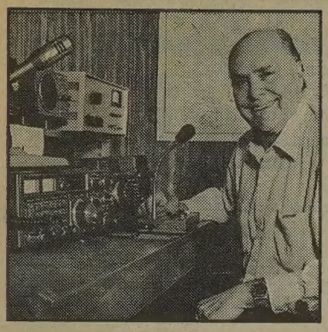

QLF

by Wayne Green W2NSD/1

Is Your HT Dangerous?

You probably missed the Dec. 16th Connie Chung show where she tackled the cellular telephone danger controversy. Well, those darned things are dangerous, and so is your HT—particularly if you are using PL tones. Where the controversy comes in is when the manufacturers and retailers try to fight scientific facts with baloney. So we hear Paul Harvey telling his huge listening audience that a recent report from the University of Utah has cleared cellular telephones as far as being a health hazard. Don't Motorola and the other manufacturers wish!

It's the same deal with police radar transmitters. These are causing cancers all over the country, no matter how much the manufacturers deny it. They are faced with humongous lawsuits, so they have to deny it.

In this case you don't have to take my word for all this. There are plenty of books out there for you to do your own homework. Have you read *Electromagnetic Man* by Smith and Best yet? Tsk! The subtitle is: "Health and hazard in the electrical environment." Then there's Paul Brodeur's 1993 book, *The Great Power-Line Cover-Up*. The subtitle is: "How the utilities and the government are trying to hide the cancer hazards posed by electromagnetic fields."

I found *Cross Currents* by Dr. Robert Becker (1990) absolutely fascinating. The subtitle is: "A startling look at the effects of electromagnetic radiation on your health." This lead me to Becker's 1985 book, *The Body Electric*, which is a must-read. Subtitled: "Electromagnetism and the foundation of life." Hey, you're into an electromagnetic hobby, so you ought to find out about how to keep hamming and keep healthy at the same time.

By the way, every one of the above books—as well as the Connie Chung TV show—cite Ross Adey K6UI as a top scientific expert in the field. Ross has sent me hundreds of reprints of research papers backing up his conclusions as to the dangers of electromagnetism to life. If you're interested in looking some of these up you can get a 64-page list of references to these published papers from the *73* BBS (603-924-9343, 300-2400 baud, 8 data bits, no parity, one stop bit).

Unless you cheated by memorizing the theory to get your ticket, you know that when you pass a current through a conductor it generates a magnetic field. And when you pass a magnetic field through a conductor it generates an electrical current. The currents in our bodies, which have a profound effect on how our bodies work, are in the nanoampere range. Thousandths of a microampere. It doesn't take a scientist to figure out that a radiating radio antenna held up near your brain is going to generate more than nanoamperes inside your head. And this has nothing to do with the ability of radio waves to cook meat, which seems to be what was being measured in the Utah research. We're talking about screwing up how your cells talk with each other and how they pass along instructions for making new cells—something which scientists are just beginning to try to understand. Wait'll you read the Becker books! You'll have tons to talk about on the air—for a change.

There are three small books by Davis and Rawls on magnetism which are easy reads and full of information. Look for *Magnetism and Its Effects on the Living System, The Magnetic Effect,* and *The Magnetic Blueprint of Life.*

Other Books

Once I've gotten you interested in not killing yourself prematurely, I've got a bunch more books you'll find interesting. The easy way out on all this is to just say, "I don't care what all those scientists say, it's all baloney." I've gotten several letters from readers expressing this enlightened approach.

How else are we doing ourselves in as a result of modern technology? Well, I just got a big stack of research papers backing up Hal Huggins' contention that dental amalgam, a combination of silver and mercury, is causing all kinds of lingering illnesses. You'll want to read his book, *It's All In Your Head.* I guarantee you'll have every amalgam filling removed from your head and from everyone in your family. I'll try to get some time to do a good solid book review for you on this one—if you're interested. Maybe you don't care if you are being slowly poisoned or being exposed to multiple sclerosis, diabetes, and a few other miseries mercury can cause.

Then there are some wonderful books on the effects of light on our health which you'll enjoy. You'll also, I'm sure, become a fanatic about getting full spectrum lights into your home, office, and into any school rooms your children are using.

There are so many exciting things to learn about that I've been taking a suitcase full of books with me on my recent travels. I read while my wife drives. I read while in airport lounges and on the planes. I read while waiting for elevators.

Trips? As this is written I'm just back from a cold fusion conference in Maui. I'll go into what's happening in that field in my *73* editorials. In case you have not been doing your homework, I assure you that the reports of the death of cold fusion are premature. I talked with people who are generating enormous amounts of power in their lab experiments. I'm talking about four kilowatts per cc of palladium. This looks like it's going to provide very low-cost, pollution-free power within a few years. It also looks like an incredible investment opportunity.

I used the Maui conference as an excuse to go out there a few days early and scuba dive all six major islands. By the way, that's pronounced Mau-e. They spell is Mau'i and there's a slight pause before the "i". Ditto Lana'i, Moloka'i, and Hawai'i.

A few days before that I was in Berlin for a music conference. I'm in the music business. And back in September I celebrated my birthday with a diving-ham radio-music visit to 11 Caribbean islands. Well, I only went diving on nine of 'em. The hams on Guadeloupe and St. Lucia kept me so busy I didn't have time to go diving.

In August I attended a science conference in Colorado, and in July a subtle energies conference in Monterey (California). It's a pity you've been missing these conferences, but at least you can read some of the books written by the scientists who've been giving their papers. With just a little encouragement I'll list more of the books I've been reading recently. Like Gene Mallove's *Fire From Ice,* the story of cold fusion. All that stands between you and knowing what you're talking about is some reading.

Ordering Books and CDs

[Editor's Note: Wayne often references books and CDs in his editorials. The books are often available from Uncle Wayne's Bookshelf; the CDs from IMPS by Mail. Both can be ordered by telephoning (800) 234-8458 or (603) 924-4196, or by faxing (603) 924-8613.] RF

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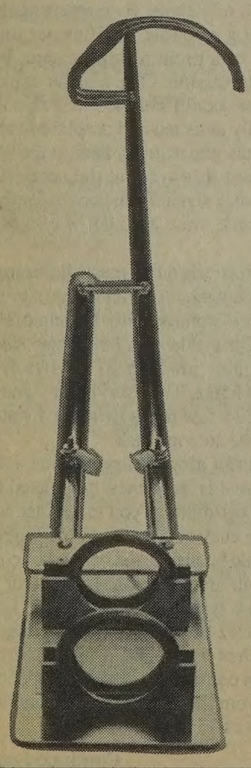

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RF kit review

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Telephone: (716) 924-4560
Price Class: $149.95 basic kit; $24.95 for CFX matching case and knob kit.

Ramsey Electronics' FX-146

2 meter transceiver kit.

by Peter Putnam KT2B

How many times have you heard this: "Nobody builds kits anymore. The parts are so small and the circuits are too complicated. Who has that kind of time on their hands? Besides, at today's prices, it doesn't make sense."

Well, some of this is true. With the advent of Surface Mount Technology (SMT), robotics, and wave soldering equipment, some pretty complicated radio circuitry is stuffed into amazingly small places. What was once impossible is now commonplace!

As a newcomer to amateur radio, you've probably had enough exposure to electronics and communications theory to have a basic grasp of how your 2 meter hand-held radio works. Now let's have some fun for a moment. Suppose your curiosity has been piqued, and maybe you'd like to know more. Maybe you'd even like to try your hand at soldering a few parts together and see if you can get them to work.

But you're operating with a limited budget, and free time is "catch as catch can!" And how can anyone still learning the ropes about the hobby be expected to build anything without an experienced helper to answer questions and check your work as it progresses?

Outta luck? Not at all, if you (A) have about $175 available, (B) can find a few spare hours over a few weekends, and (C) can scrounge up a few basic tools. If you're willing to try something new and invest a few hours of your time, you'll have a brand-new, packet-ready 2 meter FM transceiver to show for your efforts!

More importantly, you'll learn more about how a radio works by building it yourself, and (hopefully) won't hesitate to "pop the cover" and make repairs when needed, or modifications when desired. Sound interesting? Read on!

Overview

The Ramsey Electronics FX-146 is what makes it all possible. The FX-146 (Photo A) offers 12 user-programmed channels and 3-5 watts output power in an attractive case kit (optional). Frequency coverage can be set anywhere from 136 to 174 MHz using common 1N914 diodes, allowing reception of NOA weather broadcasts (among other things). It uses most standard speaker/microphones. *[Editor's note: Ramsey offers a quality speaker/mike for $24.95. If you mention that you saw this article in* Radio Fun *when you order the FX-146, you can buy the matching speaker/mike for only $10.]* The unit also has a rear-panel DIN packet connector. Controls are kept to a minimum, as are features—you won't find scan capabilities and multiple VFOs here.

What you will find is a solidly-engineered product that is fairly easy to build, test and operate. Only one circuit board is used for all components, and it's a wide-open layout which makes assembly a snap. Component locations are all silk-screened onto the board and plated-through holes are used extensively to ensure good solder connections.

The "genius" of this kit is evident in two ways: The simple but effective design, and the well-written assembly manual. No matter how good a kit of any kind may appear, it sinks or swims on its manual! And the FX-146 manual is as good as any I've ever seen or used over the past 25 years, including Heathkit, EICO and Lafayette products.

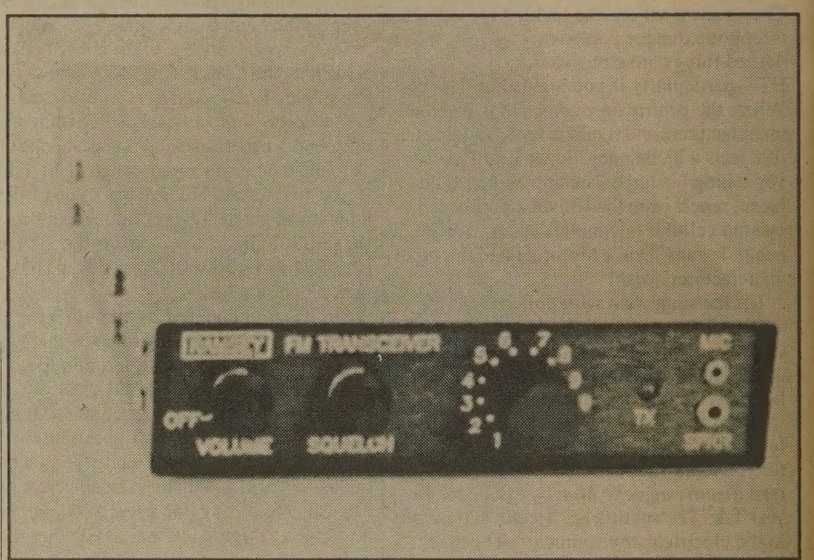

Photo A. The Ramsey FX-146 2m FM transceiver kit.

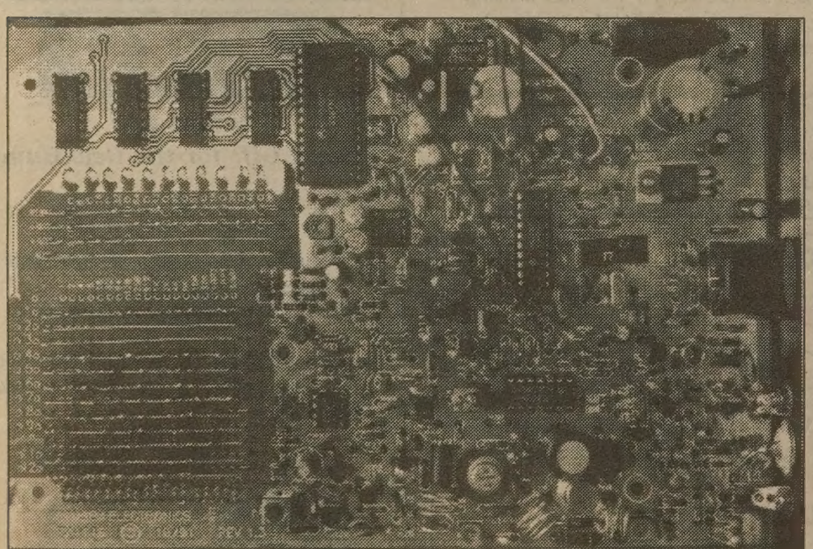

Photo B. Close-up of the FX-146 (top view) showing all components. Note the clean, simple design.

What's Inside

There are surprisingly few parts in the FX-146 (see Photo B). A simple frequency synthesizer is fashioned using a Motorola 145152 chip, a voltage-controlled oscillator (VCO) and a few crystals. The outputs from this synthesizer (along with several 1N914 small-signal diodes that you select and install) are used to determine receive and transmit frequencies. Additional 1N914 diodes select repeater offsets or simplex channels.

One of the benefits of miniaturization is the MC3335 integrated circuit that functions as a complete FM narrowband receiver! These ICs make it possible to build today's popular "micro-sized" hand-held radios, without sacrificing performance. Of the remaining ICs, one functions as a two-stage microphone amplifier and transmit/receive switch, while the other is a 2 watt audio output stage to drive your speaker/mike.

The basic circuitry in the FX-146 is not much different from your off-the-shelf stereo receiver or TV set. The Motorola 145152 synthesizer is constantly running as part of a loop which includes a voltage-controlled oscillator (VCO) and a phase detector. All three components work together to generate a stable, reliable output signal in a phase-locked loop (PLL). This signal is mixed with various crystal oscillators to generate the receive and transmit frequencies.

How It Works

When an incoming signal (say, 146.520 MHz) is received at the antenna, it is mixed together with another signal 21.4 MHz lower (125.12 MHz) coming from the PLL circuit. The difference frequency of 21.4 MHz is the first IF (intermediate frequency) and is filtered and mixed a second time with a crystal frequency of 21.855 MHz. The difference now is only 455 kHz, and this is called the second IF.

Why two "IFs"? Converting a signal twice is nothing new. In fact, this dual-conversion design has been around for many years! The answer is selectivity. By converting the signal twice, it's possible to filter out undesired signals to a greater degree than by using direct-conversion. (The manual explains this in greater detail.) This 455 kHz signal is what is actually detected and amplified to produce the signals you actually hear in the speaker.

Without this system, the receiver would detect every signal from here to Timbuktu, all at the same time, and that would be quite a mess!

The process is pretty much the same on transmit, although simpler. The synthesizer frequency is mixed with that same 21.4 MHz signal. The synthesizer frequency (say, 125.12 MHz again) plus the 21.4 MHz IF equals 146.520 MHz. This low-level signal is then amplified a few times to about 4 watts and is sent to the antenna jack.

Oh, and I almost forgot—that same low-level signal is frequency-modulated (FM) by the speaker/mike as you talk. That is, the actual frequency of your transmitted signal varies just a little bit above and below its center point when you are speaking. In amateur service, this shift is typically 5 kHz total (2.5 kHz above and 2.5kHz below the center frequency). It's not much of a shift and is called "narrowband FM." (In comparison, a normal wideband FM signal from the FM broadcast band will shift as much as 75 kHz either way!)

Continued on page 6

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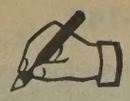
letters



Write to: Radio Fun, 70 Route 202-N, Peterborough, NH 03458

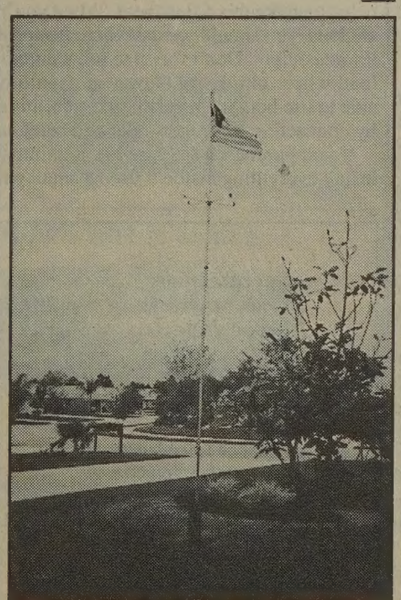
Keith Carlson, Tampa FL Wayne, yesterday I got the November issue of *Radio Fun*. Good work! Definitely a keeper. I'll end up subscribing eventually. Once again, I enjoyed your editorial ("QLF"). I like your adventurousness, goading and ideas for ham radio activity and trying new things. Generally, your ideas for continuing growth, learning and new horizons are ideas I relate to. How can people get through school and then kind of shut down, coasting on popular prejudice, just letting the old noggin do daily maintenance tasks and little else? I'm not trying to be smug; I just don't understand losing passion for learning. By the way—what are these books on health and technology you keep alluding to?

[Editor's Note: Wayne often references books and CDs in his editorials. The books are often available from Uncle Wayne's Bookshelf; the CDs from IMPS by Mail. Both can be ordered by telephoning (800) 234-8458 or (603) 924-4196, or by faxing (603) 924-8613.]

Bud Palmer N4WRF, Stuart FL I live in a small development that is governed by a Home Owners' Association. The rules say that there will be no transmitting or receiving antennas. I was aware of these rules when I moved in. Being a rather new ham (perhaps ignorance was bliss), I was sure there was a way to get on the air.

I first adorned my attic with many dipoles and full-wave loops. This worked fine for a while but, like most hams, I wanted more.

Finally I got smart and found a 4 B.T.V. by Hustler. It's been up for over three years and seems to be able to withstand normal wind loads. The flag is 2' X 3', and the base is covered by a piece of six-inch PVC painted green. The six-point reflector that is five feet down from the top is marked with S, E, W, N on four points and an arrow and a tail on the other two. The radials were buried after dark. It works great on 10-15-20-40. Wayne, this just proves again that any ham worth his salt can get on the air no matter what the conditions are. RF



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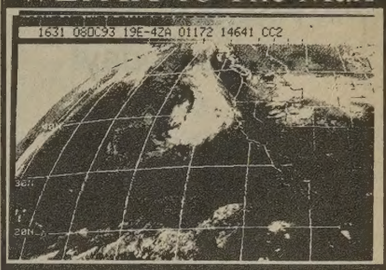

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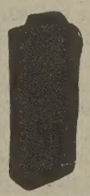

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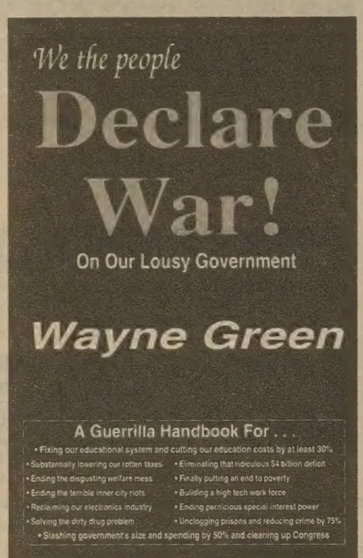
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Ramsey Electronics' FX-146

Continued from page 4

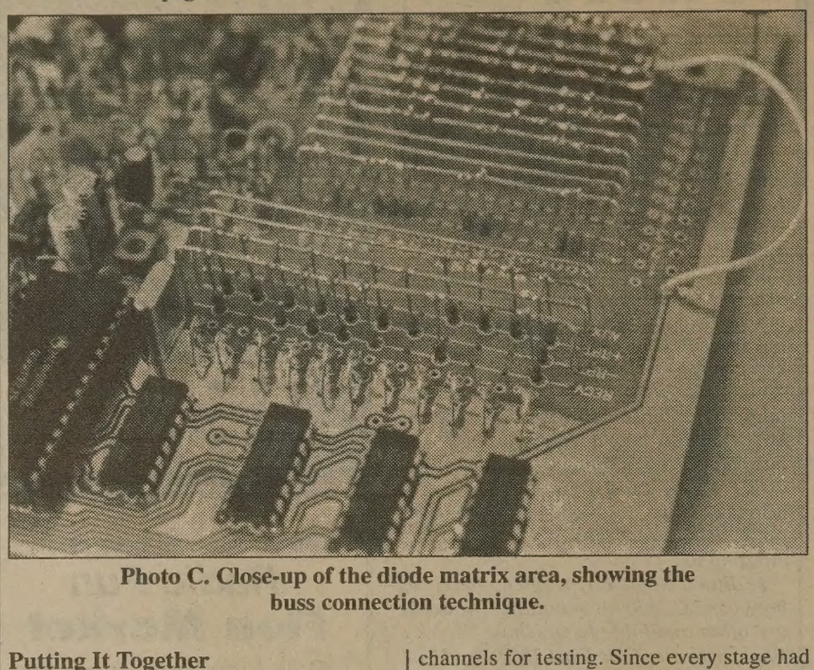

Photo C. Close-up of the diode matrix area, showing the buss connection technique.

Putting It Together

The actual kit assembly was fairly rapid. Granted, I've built a few kits over the years, so I can afford to take a few shortcuts now and then! But even experienced builders can screw up just as well as beginners. For one thing, although I've soldered dozens of small chip capacitors and resistors over the years, I managed to drop the *only* chip capacitor in the *entire* kit into a crack along the wall under my workbench. (All those years of practice paid off big!)

One suggestion here: Use a nice piece of white posterboard as your work surface, and masking tape doubled over to hold loose components until you need them. Another good way to keep parts from jumping around is to grab a few plastic deli containers out of the plastic recycling bin and use them for storage. (What? You don't recycle? Shame, shame . . .)

As I mentioned earlier, the Ramsey system of construction is like having a silent, experienced partner. The manual uses the old double-check system so common in old Heathkits. Check your work as you complete it, then go back after you finish a section and check it again. Not only that, you can actually apply power to that section and test it out before proceeding to the next step—in effect, you have three chances to ensure you've done the job right.

All the parts are very clearly marked. You may have (as I did) a few substitutions. In just about every case, the substitution is an upgrade to a better part, or one of equal performance at a lower cost. (See? Those guys at Ramsey never sleep. They stay up all night, trying to think of ways to make your rig work better!) Make sure you follow all pin orientations on the ICs and transistors—when in doubt, look at the diagrams. Once soldered in, ICs are quite difficult to remove.

You'll find as construction finishes up that you'll have some extra wire left over, and perhaps a spare capacitor or resistor. As long as every part is checked when installed, you're in fine shape. The wire lengths are purposely longer in case you, uh, slip up when winding a coil. Like I said before, everybody makes mistakes now and then. (Now, where's that doggone chip capacitor . . . ?)

Finishing Up

I installed diodes in all but two of the 12 channels for testing. Since every stage had checked out OK previously, it was a simple matter to apply power and "ring out" the receiver. I used a strong local repeater for calibration. The only piece of test equipment needed here was a volt-ohmmeter (VOM) which, if you don't own one, Ramsey will gladly also sell you. I used their model D-1200 to tweak up the VCO and receiver section. This tweak is easy and takes very little time.

One more note about the diodes: Make sure that both ends are soldered completely to the PC board and the diode buss (see Photo C). A loose connection here will result in no output power and no signals on receive when that channel is selected. Follow the technique described in the manual and you'll be okay. A good way to do this is to support the board between two wooden blocks, and drop the diodes completely into their correct holes.

Solder and trim the buss connections, then flip the board over and finish the connections to the holes.

The transmitter requires a small bit of fussing to peak up. This is accomplished primarily by tuning two capacitors and expanding or compressing turns on three coils around the driver and final transistors. A wattmeter helps to make this adjustment. When you're all done, you should see anywhere from 3 to 5 watts output. Don't forget to use a dummy load when tuning up! Now you should be able to use both the receiver and transmitter by connecting a speaker/mike and antenna.

If you purchased the case kit, it's time to install everything inside. I used a small pair of pliers to tighten the mini- and sub-mini phone jacks, being careful not to scratch the panel.(I usually do my case assembly on an old towel to prevent abrading and marring the case.) All holes for switches, controls and jacks are pre-drilled and painted, so you just have to pop each control in and fasten it. Orientation of the volume and squelch controls as well as the channel selector is made easy by indexing holes.

Break Out the Champagne

The finished FX-146 makes for a snazzy-looking piece of equipment. All that's required to finish things off is a speaker/microphone, and almost anything on the market will do. I use an ICOM HM-9 and HM-54 with mine. (Of course, if you don't own a speaker mike, Ramsey will gladly sell you one.) *[See editor's note above.]* You'll need a power supply as well, providing about 12.5-14 volts DC @1.0 amps regulated.

Your antenna options are endless, although I don't recommend sticking a rubber duck out the back connector—RF will get into your power supply.

The case kit has two threaded holes which can be used with a mobile bracket. Four stick-on feet are also provided if you just want it to sit on the shelf and look pretty. Don't forget—the FX-146 is also packet-ready through the rear panel connector. It makes an excellent packet rig without taking up too much space or power.

Best of all, you can lean back in your chair and admire something you built yourself. Your radio is no longer just some mysterious "black box" filled with zillions of unidentified multi-colored parts! It's actually a rather attractive-looking rig with a fairly simple (but impressive) circuit design that performs as well as several $400+ radios I won't mention here. The difference is in the engineering: Stay away from unneeded "bells and whistles" and stay with a basic, tried-and-true concept.

But There's More!

Now, for all of you who just finished this review and are thinking, "Nah, it can't be that easy!": Well, your ship has just come in. The editorial staff and I are so convinced that you can build this kit that we're going to build another one, step-by-step, right here in the pages of *Radio Fun*. Now you'll have *four* ways to check your work as you proceed with the FX-146 assembly. Sound good? You bet.

All you have to do is scrape up the $$$, assemble the tools, and we'll get right to work, starting in an upcoming issue. Meanwhile, be sure to check out the companion article "Assembling the Ramsey FX-146 Kit" which is also in this issue. See you soon! RF

Specifications

Frequency Range	Any 20 kHz segment between 140 & 180 MHz
Repeater Offsets	Simplex, +600, -600, plus user-programmable
Packet Operation	9600 baud, 5-pin DIN jack
Modulation	Narrowband, true direct FM
Power Requirement	1.0 amp transmit, 5 watts output
	200 mA on receive, no signal
Antenna Impedance	50 ohms, unbalanced
Microphone Impedance	600 ohms or high impedance
Transmit Output Power	3-5 watts RF @13.8 VDC
Receiver Sensitivity	Less than 0.35 µV for 12 dB SINAD
Receiver Selectivity	-6 dB +- 7 kHz, -60 dB +-15 kHz
Squelch Sensitivity	Less than 0.25 µV
Audio Output	More than 2 watts

Wanted: Young Hams

Once again, Carole Perry WB2MGP is looking for articulate, active amateur radio youngsters up to age 18 to be interviewed for possible participation in the Dayton 1994 Youth Forum. This year's forum will be bigger and better than ever. Please contact Carole at P.O. Box 131646, Staten Island NY 10313-0006, or telephone her at (718) 983-1416. *TNX WB2MGP.*

Huge Cable

A private venture with financial backing in the United States, Japan, and the Middle East is planning to construct the world's longest under-sea fiber-optic cable, linking Europe, the Middle East, and Asia through 13 landing points. The new cable will join existing undersea links to open up broad bandwidth international multimedia services by 1996.

The Fiberoptic Link Around the Globe (FLAG) will cover 18,000 miles, from Britain through the Mediterranean Sea and Indian Ocean to Japan. FLAG is expected to complete the first global high-capacity fiber-optic highway of great capacity. The link would support 600,000 conversations simultaneously and support teleconferencing and entertainment video, too. The huge cable would likely compete with satellites for business. *TNX Electronic Engineering Times, December 6, 1993.*

Boyer Wants His HT Back

According to newspaper accounts, Chris Boyer KC6UQG, who accessed a sheriff's department radio frequency to summon medical help for an injured friend, now wants his portable radio back. Reportedly, Boyer first tried to get help via amateur radio, business band, and cellular phone, but to no avail.

Boyer contends that he made a responsible decision to use the sheriff's frequency only after exhausting all other communications options. His friend had been hurt in a mountain bike accident and was bleeding. Two weeks after the incident, Boyer was called into a meeting with FCC and sheriff's department officials, where he surrendered his radio. It is not clear whether the radio was actually confiscated, or if it was volunteered in lieu of prosecution. *TNX Westlink Report, No. 662, November 26, 1993; W5YI Report, Issue #23, December 1, 1993; and The San Diego Union Tribune.*

Power Stream

Three men claim they have invented a battery which is powered by a plentiful natural substance available at low cost—urine. Many scientists are highly skeptical of the inventors' claims, especially without an explanation of the battery's purported chemical reactions and construction.

The urine battery's inventors, Nelson E. Camus, Edgar Aguayo, and Ismael Valle, are partners in an electronics company called Nel Nithium Electronics. They say their information is a secret they are not about to share.

The men are looking for investors with $5 million. They claim their home power plants will be cheaper and smaller than existing power sources, are environmentally sound, and will boost the economy. They estimate the cost to perpetually power an average home to be around $500.

TNX Associated Press; San Mateo Times; and Palo Alto Amateur Radio Association PAARA Graphs, December, 1993.

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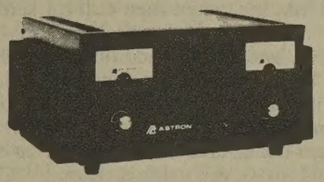

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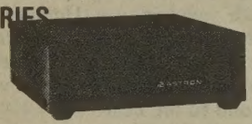

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SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

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MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

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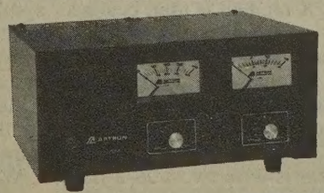

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

Assembling the Ramsey FX-146 Kit

One builder's experience.

by Peter A. Bergman NØBLX

Can *YOU* build it? Can you strip 1/8" of insulation from the heavier black wire and solder it in the hole marked ground? That's step A1.

How long will it take? Ramsey says two to four evenings. I suppose that is possible, but why rush it? I stretched it out to about two weeks of spare time. But, over half of that was spent with the book and once I actually started building I got interrupted a lot: work, eating, sleeping, Diana Rigg film festival.

What about tools? Not many are required. Dikes, needle-nosed pliers, 25 to 40 watt soldering pencil, screwdriver, 0.5mm resin-core solder, tweezers, etc. A magnifying glass, a large sewing needle or dental pick, and a wide paint or dusting brush are handy too.

For test equipment you will need a decent DMM, a 50 ohm dummy load, a VHF wattmeter, a speaker, a microphone, and a well-regulated 12 volt supply rated at about 1-2 amps. I used a large gel-cell battery. A frequency meter is handy but not essential since you can adjust for the best-sounding audio from your local repeater. If you have an RF signal generator you can have some fun, which is the idea of the whole thing. If you don't have access to a wattmeter you can measure the current in your power supply line and adjust for a peak which will be around 1 amp on transmit. For a dummy load you can solder four 200 ohm resistors inside a PL 259 connector. The duty cycle is pretty short, but so are your tests.

The kit I received from my dealer was complete with a silk-screened, plated-through board, and all parts including connectors, controls and wire. It was accompanied by a very complete reference and assembly manual, two copies of the schematic, and an almost double-sized parts layout diagram.

As I drew near the end of the assembly process I thought Ramsey had slipped up and included four extra capacitors. The FX-146, as designed, has a broad front end—about 20 MHz worth. If you find as you drive about that you are hearing all manner of strange bleeps, squeaks and blonks, the solution is simple: Install the four "extra" capacitors per Ramsey's instructions and you will narrow the receiver so it covers just a bit more than the 2 meter band.

WARNING! Do not transmit on any frequency for which you and the rig are not properly licensed.

WARNING! More kits fail because of poor soldering than any other cause. Learn to solder before starting a project of this complexity. If you are unsure what a good solder joint looks like, try this: Fill a glass with water. Take a scrap of wire or toothpick or whatever and stick one end of it into the water, then pull it up about 1/8". Look closely at the point where the wire and the surface of the water meet. This is what a good solder joint looks like. If a solder joint looks like a galvanized nail stuck through a powdered sugar donut, take it apart, clean everything and do it over, using a clean, tinned, hot soldering tip and resin core solder.

WARNING! Do not carry solder to the joint on the soldering tip. Heat one side of the joint and then apply solder to the other side. If everything is as Kester intended, the solder will melt and flow through the joint to the heat.

WARNING! Almost as many projects fail because of people not following directions as from poor soldering. People generally fall into two categories: the folks who follow directions and the other guys. Personally, I follow directions. It makes life easier.

Assembly starts in the left rear corner of the board with power input, filtering and regulation, plus the rear I/O port. Then you test for +12, +5 and +8 volts DC at the proper points.

WARNING! When digging for diodes be very careful that you don't lose or use one of the PIN diodes you are going to need later. If you lose or ruin a couple of 1N914s it won't matter much, but there are no spare BA482s. Speaking of diodes, there is no reverse polarity protection so you might want to add a "crowbar."

During Step B you will build and test the receiver audio amplifier. The audio amp IC is soldered directly to the board. Do not use a socket! The LM380 needs the heat-sinking. When testing it do not use a headset. The audio stage puts out enough power to blow the wax out of your ears.

WARNING! I don't think it's just my eyes. It is harder these days to be sure about the color of the bands on resistors. If you are unsure if the third band is red or orange or brown or purple, check the value with your DMM.

One of the many things I like about the Ramsey FX manual is that, besides the very nice schematic and board layout sheet, each stage in the manual includes the schematic and layout for just the section you are working on. Sorta like the "good-old-days," with more theory.

Stage CR starts with two-and-a-half pages of theory and produces enough of the receiver stage to actually hear something.

WARNING! The only error in the silk-screening occurs in step CR 17. C7 is shown backwards. Follow the directions on the addendum sheet. This might be corrected by now but check those extra sheets.

WARNING! Some of the preformed component leads may short together if just stuffed into the predrilled holes. You may need to straighten some of these before inserting them.

Step CR 24: The quadrature coil, L1, was not marked the same way the book said, but the only way to install it wrong involves the use of a large hammer. When looking for an unfamiliar part sometimes I find it helpful to take the reverse approach. Eliminate everything that is not a dylithium-crystal-phase-transducer-bracket and what remains must be it.

CR 4a,b,c, T1: If you have been waiting for the chance to wind an enormous transformer that hums and glows in the dark, keep waiting. T1 is less than a quarter-inch in diameter and the secondary is pre-wound with enameled frog hair. All you get to do is wind a couple of turns for the primary. Follow directions, get yours to look like the picture in the book, and it will work. I say that a lot.

CR Theoretical Test: I have an old signal generator I'd never used before so I was able to perform this optional test. Heard a foreign broadcaster—on 13 meters, I think. Anyway, it worked.

Use the paint brush to dust the little wire scraps and other bits off of your PC board and work surface before performing any tests. Then examine both sides of the board closely for wire scraps, solder blobs, untrimmed leads, etc. Go over the board frequently with your magnifying glass and correct any cold solder joints or solder bridges when you find them. Make sure the solder trace pattern looks the same after you finish soldering a joint as it did before.

Antenna Input and RF preamp stage DR: In this stage you'll finish the back of the board and work your way over to the receiver stage you built earlier.

Stage E-F, the voltage-controlled oscillator: The two-page theory section here contains one of the few errors I noticed in the book. The second paragraph says D1 instead of D3. The assembly portion is correct. Use your own 2k, 5k or 10k potentiometer and hookup wire to perform the VCO and receiver test. I was very pleased with the audio quality and very, very pleased that it worked. What a rush!

In Stage G we get down to the real nitty-gritty, the PLL synthesizer. Before starting this project I couldn't spell synthesizer—or PLL either. Now I've built one.

For reasons that will be obvious later, you might want to skip Step G5 and leave C80, the 39 pF capacitor, in its baggy for the time being. You might also want to read the CAP sidebar.

Watch those capacitor markings! If you install a 0.01 where you were supposed to install a 0.001, things may not work the way Ramsey intended. You may not like it, either.

Double-double-check your work at every step. I may sound like a Pompous Pain in the Posterior about this, but if you select the correct part, insert it into the proper hole in the board and do a clean job of soldering, this kit will work.

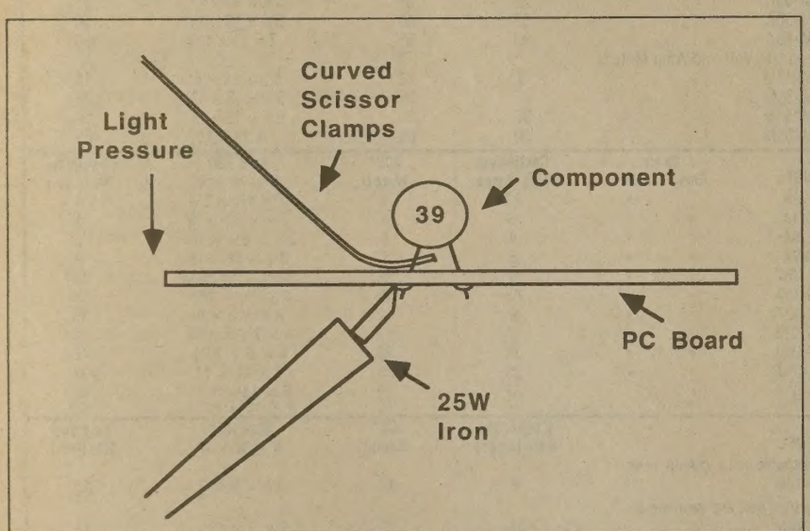

Figure 1. The proper way to remove capacitors and other small components from the board.

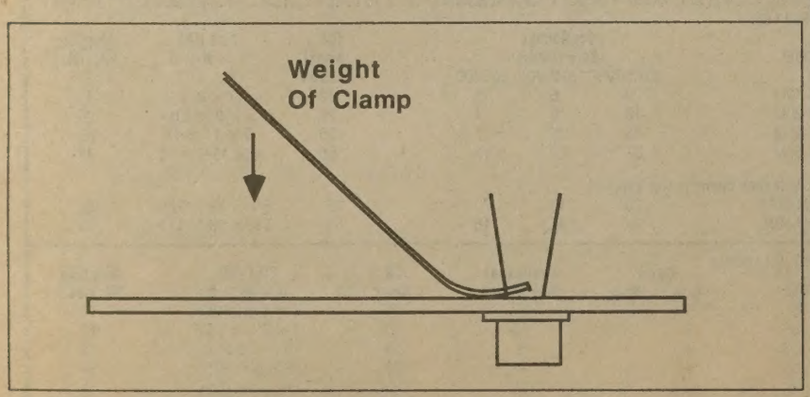

Figure 2. A good method for holding and heat-sinking a component while soldering.

If not, double-double-check your work again. As a case in point, I was happily working my way through to the receiver adjustment section and had really gotten into the supply of 100k resistors. I got to adjustment Step 6 and L7 would not adjust to anything close to the required 1.27 volts, nor were there 4 volts on pin 5 of U5. After removing power I turned the board over and started to work with my magnifying glass, expecting to find a pinpoint-sized solder bridge somewhere. Not quite! I could have used a stepladder for this one. Somehow, in all the excitement I had laid a lovely new trace that tied about half the pins on U7 to someplace on U6. After cleaning up that mess L7 adjusted just fine.

I did not have a VHF frequency counter so I programmed in 146.52 and the local repeater at 147.03, intending to listen to 52 and the repeater output while I adjusted C8 and L1. NUTZ! All I could hear was the 147.015 machine 60 miles away. Now what? I was really confused because there was a code practice session going on and I thought I'd gotten into the 40 meter band somehow. Hi Hi!

I double-checked programming, fumed a little, re-read directions. AHA! "If frequency is too low and cannot be adjusted any higher, clip out C80, 39 pF." I unsoldered it. Worked fine.

Removing a simple component like a capacitor or resistor does not have to be a big hassle. See Figure 1. Take a new grip closer to the board, or move to the other lead if you run out of room. Use light finger pressure on the forceps while heating the joint.

If you are trying to hold a part, like Q8, snug to the board for soldering you can do the opposite. These locking scissor clamps are very handy. They make great heat sinks too. They are readily available through most part/tool catalogs and are usually in a box near the cash register at surplus tool outlets. I just bought another pair for $1.50. Like I need more!

Stage M starts with another page-and-a-half of theory.

WARNING! You've been working with lead solder, right? Lead is toxic, right? When you break for a snack wash your hands. Now your hands are greasy so wash them before going back to work. You don't want cholesterol smeared all over that lovely PC board.

I cut up a socket I had in the junk box to produce one for 14-pin U4. If you don't have any sockets laying around don't sweat it too much. Just solder the LM324 directly to the board. Oriented correctly, of course. You don't want to let the smoke out. If you do it won't work.

In M26 you get to install the last 100k resistor. There are so many of them it seemed like a big deal at the time.

If you blow the fuse during the Stage M tests make sure you replace it with one of the same value.

At last! In Stage TC we get to wind some coils. Make sure you use the smaller bus wire to stuff L9 and L19. The size difference isn't much so if the wire won't slide into the core easily, try the other stuff.

After winding L13, 15, and 16, screw them back on the 5/16 x 18 bolt Ramsey provided and set it aside until you need the coils.

Stage TX: Follow the directions exactly. Soldering the case of Q8 to the ground plane raised hairs on the back of my neck, but it will work.

TX3a,b,c,d,e: If you have worked with surface-mount components before it's no big deal, but if this is your first time, just build carefully and it will work.

When it comes time to adjust FM deviation with R46 for "best-sounding speech," remember that best may not be loudest.

If everything is working up to this point you have about run out of chances to put the wrong part in the wrong hole.

When adjusting C84, C74, L13 and L16 for maximum RF output, remember that the reading you get depends on the accuracy of your wattmeter and the value of the DC supply voltage. Be careful while adjusting the coils that you don't short any of the turns to the ground plane. Also remember that you are dealing with a power curve—the output will not be flat from DC to daylight.

I did not have a decent VHF wattmeter at home so I measured the current in the DC power supply line. I got 0.2 amps on full volume receive and 0.94 amps on transmit, which is pretty close to Ramsey's specs.

On-the-air reports of both signal strength and quality have been good so I must have done something right. Of course, when you are asking for reports there is always that clown who will answer you by name and callsign and then tell you that you're too garbled to copy. Tell him you have a 90-foot telescoping, fold-over tower to give away. He'll suddenly be able to copy every word. Hi Hi!

The optional case kit impressed me. The finish and the silk-screening are very nice. The case is heavy steel and should provide adequate shielding and heat-sinking. The board bolts to the bottom of the case at five points on 4-40 studs with spacers. The six case parts are held together with machine screws and the holes have threaded inserts. No heet metal screws to work lose here. Before I knew it, I was already drilling holes in it for "options." Mine doesn't look like yours.

If you are thinking about getting one of the FX kits and can't make up your mind, order the assembly manual The theory portion alone is worth the $10, which you can deduct when you order the kit.

I'm having a lot of fun with my FX-146. Enough that I'm thinking about doing it again. Maybe a 2/6 meter dual-bander.

When you "roll your own," especially in a kit of this complexity, the sense of pride and ownership is very gratifying, far beyond the price of the kit. RF

Using the FX-146 on Non-Standard Splits for Civil Air Patrol, and for Other Uses

Simplex, of course, is no problem, but if your repeater uses a "weird" offset, for example 4,250 kHz or any frequency that won't divide by eight, I have some bad news and some good news.

First the bad news. As designed, the FX-146 will not work that kind of split. The good news is that it is easy and cheap to fix.

The offset diode matrix only goes down to eight bits. If, when you go through the repeat subtraction process to program the offset, you find that you have one to seven bits left over, you will have to do something with them. Each bit equals 5 kHz so we cannot just have them floating around.

Pins 6, 2 and 15 on U10 are normally soldered to ground, which is the source of the problem. Pin 6 equals 1 bit, pin 2 equals 2 bits and pin 15 equals 4 bits. Before soldering U10 to the board it should be fairly easy to cut the ground plane on the component side of the board to form either solder pads or actual lands that are "above" ground. Work carefully with a small hobby knife, straight edge and maybe a French curve to lay out three traces from pins 6, 2 and 15 to the area between the offset matrix and the front edge of the board. If you want the lands to be in the correct order you will have to curve land 2 and land 15 around the one from pin 6. Make sure that each land is separated from ground and that you have not cut anything else. Then you can tie each land to ground with a 100k resistor, as the ones for 32k through 8 bits are, and install programming diodes as needed.

I said above that this should be fairly easy but I don't know from personal experience because I didn't discover the problem until after I had soldered U10 to the board. Once installed, the chip covers some of the ground plane which must be cut.

I had to use a jeweler's file to cut the pins loose from the board. Then I soldered the pull-down resistors and cathode ends of the necessary diodes directly to the pins. The leads of the 1N914s were long enough to reach the offset bridge so I just covered them with insulation I stripped from some scrap #24 wire.

My thanks must go to my dealer, Pat, at Jackpine RF for his assistance and encouragement when I ran into this programming problem.

If your application uses only one repeater frequency pair but different access tones for each repeater, you could connect the front panel switch to your tone board and program just that one repeater pair into the matrix. Then, you could add a SPDT switch so you could have simplex too. Or, you can contact:

Jackpine RF
2532 Ridgeway Ave. NW
Bemidji MN 56601
800-863-1463

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793 Canning Parkway
Victor NY 14564
716-924-4560
FAX: 716-924-4555

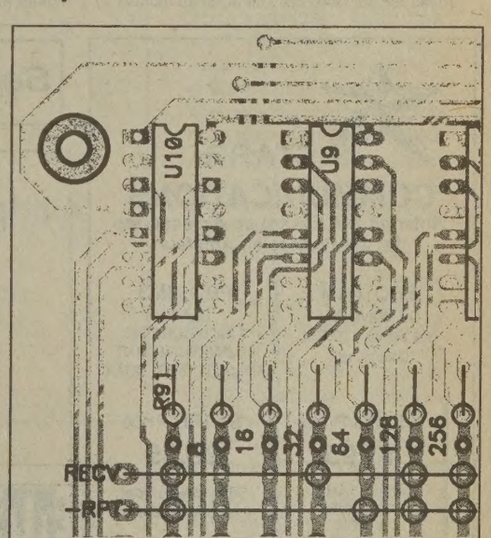

Figure 3. PC board detail for the FX-146.

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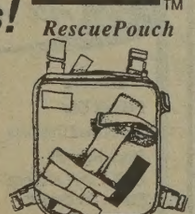

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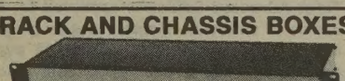

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Nobel Laureate Talks Ham Radio

by Charles Warrington WA1RZW

Dr. Joseph H. Taylor K1JT, winner of the 1993 Nobel Prize in Physics, says ham radio is not what it used to be, but it is still a great way to learn about science. He should know. After all, he started out as a ham.

Taylor and his colleague Dr. Russell A. Hulse (formerly WB2LAV) received Nobel honors in December for discovering a binary pulsar and for using this discovery to verify Einstein's general theory of relativity. Taylor is Princeton University's James S. McDonnell Distinguished University Professor of Physics and Hulse is a principal research physicist at the Princeton Plasma Physics Laboratory.

The Early Days

Let's take a look at how amateur radio played an important role in establishing such an illustrious and distinguished career. When he was all of 13 years old, Joe Taylor and his older brother Harold passed the Novice Class exam, and the two teenagers were first licensed as KN2ITP and KN2ITQ. A whole new world opened for them. Like many Novices, they were really into CW work, especially on the 40 meter band. But they also enjoyed working VHF—especially 6 meter phone, which, back in the 1950s, was still open to Novices.

Joe became fascinated with VHF—especially 6 meters, operating AM and later using single sideband. In the days before satellite communication, the 6 meter band offered a rare glimpse of futuristic space communication in the form of meteor scatter.

Meteor scatter communication utilizes the ionized trails of meteors as they pass through the E-layer of the earth's ionosphere. This kind of radio contact takes a great deal of skill because the ionization lasts for only seconds. Joe's scientific curiosity was piqued. This was quickly becoming a lot more than just a hobby.

Young Joe upgraded his ham ticket all the way to Amateur Extra Class in just two years. "No question. Ham radio got me into electronics, and that interest along with my interest in gadgeteering led me to my career in physics," said Taylor in a recent *Radio Fun* interview. Taylor says he merely followed his instincts through his remarkable career, fueled by a natural curiosity about science. He earned a doctorate in astronomy from Harvard University and most recently traveled to Stockholm to accept what must be the ultimate achievement in physics—the Nobel Prize.

Ham Radio as a Learning Tool

Today instant communication via satellites is commonplace. Back in the 1950s, however, space communication as we know it was at the cutting edge of scientific research. Taylor says that's not the only way that ham radio has changed over the years. In the '50s, a lot of hams built their own rigs, mostly from parts scavenged from old TV sets and from WWII surplus. "I would compare the change in ham radio to the changes we see in our automobiles," Taylor said. In the old days, lots of people would work on their own cars, but today you open the hood and it is so complex compared with the old days. "It's the same thing with a lot of these snazzy new rigs on the market. They are so small and complex, you can't really get in there and tinker. But that's the state of electronics now. That's technology. That's progress. I'm not saying that we should go backwards. Building today is just more difficult."

Popular 1990s wisdom maintains that today's young Americans are seriously lagging behind the rest of the world in scientific achievement. We read it every day. "It's hard to say how well we are doing as a nation as far as the scientific achievement of our youngsters is concerned," said Taylor. "In many ways, we are behind in our levels of achievement. We are not a homogeneous society. It's sad to say, but it's true. On the other hand, kids who have the best advantages in our society are holding their own."

Ham radio is still a good place for a person to learn, according to Taylor, but today there are more choices competing for the attention of our brightest young minds, most notably from computers. (This is not to say that a person can't have both, of course.) Whether you are a new ham or a young person just taking an interest in radio, Dr. Taylor says if you're scientifically inclined, physics is a great field. "There are certainly lots of things to do. For myself, I didn't spend a lot of time thinking about it (planning a career). I just did what was fun. Enthusiasm counts for a lot as far as success is concerned. If you are having fun and you're doing what you love to do, your talent will come out."

As a nation, Taylor says our future competitiveness in scientific research and development depends on what is being learned in schools right now. He calls for more of a national commitment to science education. "This is a complex question. We are not on the right course in some ways. For instance, many of our big city schools, and other places where academic achievement is not high on the list of priorities, are suffering. Other places are fine." Still, for many youngsters, ham radio provides a means to explore.

A Look Ahead

In recent years, Dr. Taylor's physics research has left him precious little time for ham radio. "Well, I haven't really been active for a few years. The last time I was really an avid operator was in the late 1970s. I was living in New South Wales in Australia for a year and had a VK2 call." For Taylor, spare time will probably continue to be a scarce commodity.

"I don't really think the Nobel Prize changes things for me. It is a wonderful honor, of course. But I have not been an unknown in my field, so I don't think it will affect my ability to attract research grants or my work. What it really affects is the number of invitations I'm receiving." Taylor has already given talks at several European universities since he received the Nobel Prize in December.

Photo A. Dr. Joseph H. Taylor K1JT. (Princeton University Photo)

As for the future of ham radio . . . "It would be a shame if it ended up like CB radio, but I don't see that happening. I don't have a problem with a no-code license, but it would be a mistake if no technical knowledge was required. The technical examination is a good incentive. Ham radio should be more than simply buying a transceiver," Taylor says. "It is a hobby that has served this country well in times of need. It would be sad if that changed." RF

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Impedance

by Larry R. Luchi W7KZE

[Editor's Note: This technical discussion of impedance is a bit more advanced than what we usually publish in Radio Fun, *and it may leave some of you in the dark. If so, read it through a few times—slowly—and things should begin to sink in. If you want to get the most out of amateur radio, you've got to really understand this stuff—not just memorize a bunch of answers for a test. We've asked Mr. Luchi to prepare a series of articles focusing on various electronic components and their properties. We'll publish them from time to time, and if you stick with them you'll be well on your way to a solid foundation in electronics.—David N1GPH]*

In past articles I have discussed capacitive reactance and inductive reactance; now we will see how they combine with resistance to form impedance. (For those of you on the road to upgrading, this article will not go to the depths needed for the Extra Class exam. If any of you are interested in more advance calculations for the Extra exam material covering impedance, polar/rectangular conversions and the j operator, please contact me at Sno-Isle Skills Center, 9001 Airport Road, Everett WA 98204.)

When we think of impedance our first thought is to the impedance of our antenna. The output impedance of most amateur radio transceivers is 50 ohms, but if you measure the output with a DC ohmmeter (power off) you will find only several ohms. That leads us to think of impedance as the opposition to an AC current or, in the case of our antenna, an RF current.

The current through a resistor will always be in phase with any voltage across it. If V increases, so does I, and exactly in phase. It is said that the AC V and I phase angle is 0 degrees.

As we discussed in a previous article, the current flowing in an inductor lags the voltage across it by 90 degrees. If the inductor itself has negligible or zero DC resistance, the phase angle of the V and I of the coil will be 90 degrees.

When both R and X_L are present in a circuit, the phase angle of the circuit as a whole will be neither 90 degrees nor 0 degrees, but some intermediate value. This will be the phase angle that is seen by the source as it looks into the whole circuit connected across it. The number of degrees will be equal to the angle formed between the Z and the R side of an impedance triangle of the circuit. This phase angle is indicated by the Greek letter θ (theta). Figure 1 illustrates a circuit having 100 ohms inductive reactance and 100 ohms of resistance.

To calculate impedance we use the following formula:

Z = impedance
R = resistance
X_L = inductive reactance

$$Z = \sqrt{R^2 + X_L^2}$$

where: R = 100Ω, X_L = 100Ω, and Z is expressed in ohms.

Example 1:

ENTER	DISPLAY
[CE/C]	0
100[X^2][+]	10,000
100[X^2]	10,000
[=]	20,000
[2nd][$\sqrt{X}$]	141.42135
	or Z = 141Ω

One method of determining the number of degrees of the phase angle is to calculate the numerical value of the ratio of the R and Z sides of the triangle. This ratio of R to Z is called *cosine*.

Although the phase angle can be found by using the cosine ratio R/Z, it can also be found by using the ratio of sides X/Z, which is known as the *sine*. The angle associated with the sine value will be the same phase angle. The ratio of the sides X/R is known as the *arctangent*, and is marked on your calculator as $\tan^{-1}$.

In a series circuit, the higher the value of X_L compared with R, the more inductive the circuit is. This can apply to your antenna using a noise bridge.

Phase Angle with Series X_L

The angle between the generator voltage and its current is the phase angle of the circuit. Its symbol is θ (theta). In Figure 2(a), the phase angle between V_T and IR is 45° . Since IR and I have the same phase, the angle is also 45° between V_T and I.

In Figure 1, the impedance triangle, the angle between Z and R is also equal to the phase angle. Therefore, phase angle can be calculated from the impedance triangle of a series circuit by the formula:

$$\tan^{-1}\theta = \frac{X_L}{R} = \frac{100}{100} = 1$$

Note: In Figure 2(a, the Phasor for V_L is positive from the horizontal axis, or the X axis. And the phase angle is 45° , halfway between 0° and 90° because R and X_L are equal.

In a series circuit, the higher the value of X_C compared with R, the more capacitive the circuit is. This can apply to your antenna using a noise bridge to find if your antenna is properly matched to your transmission line.

Phase Angle with Series X_C

As with inductive reactance, θ is the phase angle between the generator voltage and its series current. As shown in Figure 2, the θ can be calculated from the voltage or impedance triangle.

With series X_C , the phase is negative, clockwise from zero reference angle of I, because the X_C voltage lags its current. To indicate the negative phase angle, this 90° phasor points downward from the horizontal reference, instead of upward as with series inductive reactance. To calculate the phase angle with series X_C and R , the INV or second function key opens the arctangent, $\tan^{-1}$.

$$\tan^{-1}\theta = \frac{-X_C}{R} = \frac{-100}{100} = -1$$

ENTER	DISPLAY
[CE/C]	0
100[+/-][÷] 100[=]	-1
[INV][TAN]	-45

The negative sign means the angle is clockwise from zero, to indicate that V_T lags behind the leading current by -45°

Example 2: A 30Ω R is in series with 40Ω of X_C and θ_Z.

$$Z_T = \sqrt{R^2 + X_C^2}$$

ENTER	DISPLAY
30[x^2][+] 40[x^2][=]	2500
[2nd][$\sqrt{\ }$]	50
(or Z_T = 50Ω)	
$\left(\tan\theta_Z = \frac{X_C}{R}\right)$	
40[÷] 30[=]	1.33333333
[INV][tan][+/-]	-53.130235
or θ_Z = -53.1°	

Antenna Impedance

In the description of how an antenna works it was given that voltage and current is distributed along an antenna, and stated that the voltage is at the center of a 1/2λ antenna. It is more accurate to say that the voltage reaches minimum, rather than zero. Zero voltage with a finite value of current implies that the circuits resistance is approaching zero. It also implies that no energy is radiated by the antenna because a circuit without resistance could take no real power from the transmitter.

Antennas, like any other circuits, consume power. The current that flows into the antenna therefore must be supplied at a finite voltage. The impedance of the antenna is simply equal to the voltage applied to its terminals divided by the current flowing into those terminals. If the current and voltage are exactly in phase, the impedance is purely resistive. This is the case when the antenna is at resonance. Most amateur radio transmitter antennas are operated at or close to resonance so that reactive effects are comparatively small.

Impedance matching is very important as to antenna construction for an amateur radio operator. But impedance matching is also found in the design of an emitter-follower transistor circuit, where the output signal is taken from the emitter to match to the following stage of the system. Impedance then is ideal when the output of one circuit equals the input of the other. In our antenna the half-wave dipole has an input impedance of nearly 70 ohms matched to the output of your transceiver of 50 ohms. RF

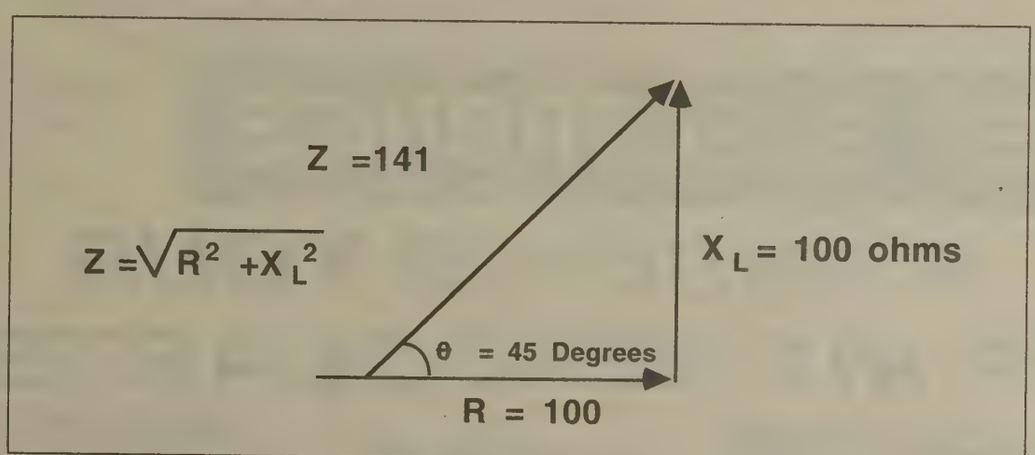

Figure 1. Impedance triangle.

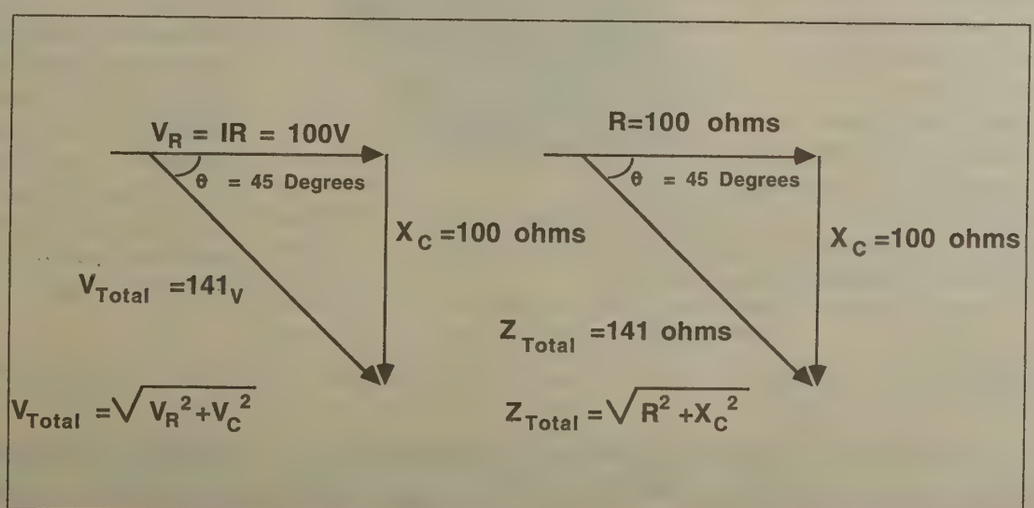
V R = IR = 100V
θ = 45 Degrees
X C =100 ohms
V Total =141 V
V Total =√V R²+V C²
R=100 ohms
θ = 45 Degrees
X C =100 ohms
Z Total =141 ohms
Z Total =√R² +X C²

Figure 2. a) Voltage triangle, and b) impedance triangle.

Passive Components

by Daryl Gerke KØFBF

Hams and other folks who design electronic circuits often mistakenly assume that the simple passive components they use will not cause electromagnetic interference (EMI) problems. After all, passive components are almost ideal, aren't they? Unfortunately, this is not true in the real world of EMI, and many EMI problems are due to unexpected passive component behavior. Let's look at the subtle ways EMI can affect passive components, then we'll share some of our thoughts in selecting components with EMI in mind.

Most passive component EMI problems are due to exceptions to the rules. For example, when is a capacitor not a capacitor? When it's an inductor (often due to lead length) at high frequencies. When is an inductor not an inductor? When it's a capacitor (due to wire spacing) at high frequencies.

We often refer to these exceptions as the *hidden schematic*. Most of the time these hidden components set an upper limit on frequency. Here are some recommendations for selecting passive components to solve EMI problems.

Capacitors

As frequency increases, the impedance of a capacitor decreases, right? In theory, yes, but in reality, the upper frequency response is limited by internal inductance and resistance, and by external inductance due to lead length. Here are some guidelines we use for capacitors:

• Aluminum Electrolytic	100 kHz
• Tantalum Electrolytic	1 MHz
• Hi K Ceramics	5 MHz
• Paper	5 MHz
• Mylar	10 MHz
• Polystyrene	500 MHz
• Mica	500 MHz
• Ceramic	1000 MHz

At high frequencies, the external inductance due to lead length becomes a significant factor. As a rule of thumb, this inductance is about 20 nanohenries per inch of lead length. Since this is in series with the capacitor, this lead inductance forms a series resonant circuit. At frequencies higher than resonance the capacitor becomes an inductor, making it ineffective for decoupling.

For example, one inch of lead length on a 0.01 µF capacitor resonates at 11 MHz; at 1/4 inch, the frequency is still only 23 MHz. The key message is to keep the leads short for high frequency applications! Other techniques, such as straps and ground planes, may also be needed to further lower the lead inductance, so the capacitor can "capacitate" as we intended.

Inductors

As frequency increases, the impedance of an inductor always increases, right? Once again, theory is nice, but in this case, the upper frequency response is limited by capacitance between the windings.

We use a simple rule of thumb for small wire-wound inductors. We just assume they don't work very well above about 50 MHz. That's not such a serious drawback, since 50 MHz is where most EMI ferrites start to become effective, and they are usually good to at least 500 MHz.

Above 500 MHz, the end-to-end capacitance can limit the ferrite's effectiveness. (Above 500 MHz, baffles or shields are often needed to limit this end-to-end effect.)

We really like EMI ferrites for energy storage device (ESD) and radio frequency interference (RFI) use. Not only do they minimize the capacitive problems, they are also resistive above 50 MHz. (Even small ferrite beads look like 50-100 ohms at 100 MHz). Unwanted EMI energy is dissipated as heat, rather than just shoved around to cause problems in another part of our equipment.

Watch out for inductor saturation. We've seen cases where filters wouldn't filter (and ferrites wouldn't ferrite) because the current was too high. For EMI ferrites (Type 43 or 28), we use the formula I = 10 R, where R is the radius in cm, and I is the current in amps where saturation commences for one turn. Thus, a small single-turn bead is good for about 100 mA, and a ferrite the size of a 2 watt resistor is good to about 5 amps before it saturates.

Resistors

What can go wrong with something as simple as a resistor? Several EMI problems can occur with this humble component. First, wire-wound resistors exhibit inductance so they should be avoided where high frequencies are a concern. (Film resistors under 2k are OK since they have less inductance than a wire-wound.)

Second, thin film resistors don't handle overstress very well, so they should not be used in ESD (Energy Storage Device) situations. We like plain old carbon composition resistors here for our friends the ferrites, which look a lot like carbon resistors at ESD frequencies.

Third, resistors can have end-to-end capacitance like inductors or ferrites. Above 500 MHz, special baffles or shields may be needed to prevent high frequency current from going around the resistor.

Transformers

The last "suspect" we'll look at today is the transformer. Although a theoretical transformer offers infinite "common mode" isolation from primary to secondary, real world transformers lose this isolation due to interwinding capacitance. Unfortunately, this allows a lot of spikes (power transients, lightning transients, etc.) right into the power supply.

For this reason, Faraday shields are common and quite popular for "noise sensitive" transformer applications. We've even solved vexing power disturbance problems with simple shielded transformers. Fancy power supply systems and regulators are not always necessary.

Like all other components, shielded transformers must be installed properly. Keep the shield ground leads short, and separate the input and output wiring to prevent high frequency coupling.

Summary

We hope we've helped to provide some insight into EMI issues as they relate to passive components. Often, it's the little details that make a big difference.

Reprinted from Kimmel Gerke Bullets *(a newsletter for electrical engineers), Summer 1993 issue. TNX Daryl Gerke KØFBF, Editor.* RF

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CIRCLE 34 ON READER SERVICE CARD

the tech side

by Michael Jay Geier KB1UM

Set 'Em Up

If you're a fairly new ham, and especially if you have a No-Code Tech license, your "station" may consist of an HT and nothing else. That's perfectly fine but, most likely, you'll eventually start thinking of upgrading your license and getting on HF. Or, perhaps, you'd like a base station for the convenience of not having to keep your walkie hooked up to everything. And, all those ads in the magazines sure can whet your appetite for some new gear! Just imagine yourself surrounded by a table full of shiny new transceivers, mikes and speakers, and perhaps even a linear amplifier to make sure you get heard in Timbuktu. This month, let's explore what it takes to set up a station.

Dough?

Does it have to cost a lot to be well-equipped? Well, if you buy all-new gear, it ain't cheap. Comparatively, you get a lot more for your money these days than hams did in the past, simply because the sophisticated technology we have today didn't exist just a few short years ago. The money that once bought you a simple tube-type radio without so much as one memory now gets you an all-solid-state beast with microprocessor control, lots of features, and maybe an automatic antenna tuner. Yes, the number of dollars you pay is higher, but the dollar isn't worth what it once was. And, of course, people earned a fraction of what they do today. Adjusted for inflation, most of today's rigs actually cost *less* than the old ones did. Still, the sticker shock can be daunting.

But you don't have to buy all-new gear. There is lots of good, used equipment out there. If you buy it from a store, you'll pay top dollar, but you'll also get a warranty of some kind. If you buy it from a friend, chances are you'll be OK as long as you're careful. If you get it from a stranger, perhaps at a hamfest, be prepared for problems. Most likely, you'll pay less, but you never know what might be inside the box. If you like technical challenges, though, this approach can be the way to go. But unless you *really* like taking risks, I'd avoid buying a big-ticket item like an HF transceiver that way. That is, until you really know what you're doing with an oscilloscope!

However you get your gear, you first need to decide just what it is you want to own. If you are using your walkie for all your VHF and/or UHF activities now, you may have discovered that while it's great for hand-held use, it can be inconvenient for base and mobile operations. Also, when you connect it to an outside antenna, you might wind up with intermod (interference from stations on other frequencies) problems bad enough to render the radio useless, especially if you live in a big city with lots of pagers and other commercial installations. So, you may want to think about getting a mobile rig. At one time they used to make base stations, but I haven't seen a VHF or UHF base rig for a long time. Nowadays, the way to go is to use a mobile rig with a DC power supply. Heck, that's basically what the base rigs were, anyway. And, the nice thing about this approach is that you can use one power supply to run several rigs, as long as the supply has enough current to power them all.

Virtually all DC-operated ham rigs made for sale in the U.S. today are designed to run on 12 volts. Actually, that's more of a conventional misnomer than an actual value. When a car's motor is running, its "12 volt" power system is really more like 14 volts. The exact value is supposed to be 13.8 volts, but most cars vary a bit, depending on how fast the motor is turning, how good the battery and alternator are, etc. Consequently, many radios can operate on voltages as low as 11 volts and as high as 15 or 16 volts, and the limits usually are specified in the owner's manual. It's crucial to avoid feeding too much voltage to a rig but, luckily, it usually isn't a problem because the DC power supplies' regulators are all set for 13.8 volts anyway. When selecting a power supply, the most important consideration is its current capacity. Just how many amps can it deliver? Scanning the ads, you may see specifications like "13.8 volts, 20 amps ICS, 10 amps CCS." What the heck are ICS and CCS?

ICS stands for "intermittent communications service." A supply with a 20 amp ICS rating would be fine for a 100 watt HF rig operating sideband, because the full current is drawn only during voice peaks, which certainly are intermittent in nature. In other words, the supply has a chance to rest between the peaks of spoken syllables. But you wouldn't want to try using that supply to run a 2 meter FM brick amplifier which needs 20 amps, because, on FM, the carrier and, consequently, the current drain are at maximum whenever you are transmitting; the modulation has no effect on them. For such an application you need a supply which can supply the required current continuously.

CCS means "continuous communications service" and suggests that the supply can deliver the specified current all day long. Unfortunately, that isn't always true. Some supplies, for instance, can deliver 10 amps CCS, but with a limit of half an hour. Longer than that and you"ll be cooking eggs on them. But who the heck talks that long on one transmission? Hopefully, none of us do (although I've heard a few windbags who came close, especially on 75 meters!). If you're running RTTY (radio teletype), SSTV (slow-scan television) or another high-duty-cycle mode, though, you can build up heat in your power supply mighty fast. In that case, it is best to reduce your transmit power by half to avoid heating everything up beyond its limits. Remember, reducing power by 50 percent only takes you down one half of an S-unit at the receiving end, so it isn't such a terrible thing.

When figuring up your total power capacity needs, add up all the current drains of all the equipment you'll be using simultaneously, and then multiply by a fudge factor of at least 1.25. That way, you won't be operating anything near its burnout point. Naturally, though, if you're sure you'll never be transmitting on 2 meter FM at the same time you do it on your HF or UHF rig, you can figure the required current by taking your most power-hungry transmitter, adding the *receive* drains of everything else and then multiplying by the fudge factor.

What Else?

OK, you've got your power supply, a few radios and, perhaps, a TNC (terminal node controller, used for packet radio). Now what? Well, hook it all up! Be sure to get the polarity right for all the DC lines or you'll do some damage. Also, especially with VHF and UHF radios, try to keep the lines to the DC supply as short as you can. You don"t need to keep them under eight inches or anything, but you don't want five-foot cords if you can help it. Why? Because, the longer the cord, the more RF energy it can pick up from one of your transmitters' antennas. And, if you're really unlucky, you might even have a length of cord that happens to resonate on your transmitting frequency, and that can cause all kinds of RF feedback problems! In particular, avoid 19-inch lengths with 2 meter rigs and six-inch lengths for 440 MHz radios, because those are about 1/4 of a wavelength, which is a resonant value. With HF rigs, most reasonable lengths of power supply cable will be far shorter than any significant part of a wavelength, so it shouldn't be a problem, although I've seen it cause trouble on 10 meters now and then.

You're Grounded!

Your station ground is the most important element I can think of. Often, a good ground can make it seem like the gremlins of RF feedback are non-existent, despite other potential problems your installation may have. A poor one, though, may make it nearly impossible to get proper operation, no matter what you do. What makes a good ground?

That's a long, complicated subject. For the most part, though, you can think of ground as a sinkhole, into which you want to be able to put any kinds of stray signals and never hear from them again. Those signals might be coming directly from your transmitting antenna, especially if it's fairly close to your station. They also might come from RF re-entering your shack via the outer braid of your coax! Yes, that does happen, particularly if you are using an unbalanced antenna, such as an end-fed longwire. If you suspect such a problem, try using a balun (balanced-to-unbalanced transformer) at the antenna, even if it"s a dipole or other balanced design; often, that'll keep the RF from coming back at you.

Ground rods going several feet into the earth make a pretty good RF ground most of the time. But, they have to be fairly close to your station to be effective because the length of the wire between the gear and the rods can resonate if it's long enough, defeating the ground's purpose. Sometimes a cold-water pipe works well, too. Before you use one, though, check that your plumbing system is indeed grounded. Some modern systems use PVC (plastic) pipe at some points, making them useless as grounds. Also, this is probably not a good idea in apartment buildings because the distance between you and the ground might be rather long, and nodes in the wave on the pipes might cause high voltages to appear on someone else's plumbing, causing a shock hazard. That"ll wake 'em up in the morning!

It may seem tempting to use the screw or third prong on an AC socket for a ground. After all, it *is* a ground connection, right? I've never seen it work. Unfortunately, the AC wiring is just too long to be effective at RF, and putting all that energy into it also can cause tremendous interference to TVs, stereos and just about anything else plugged in, including your ham gear.

To connect your equipment to your ground, use braid rather than wire. RF tends to travel on the surface of conductors, due to something called the "skin effect," and braid really helps transfer the energy to the ground connection because of its increased surface area. If you can"t get any braid, use a piece of coax shield. Even if you just leave it in the jacket and simply parallel the center conductor, it"ll work fine. What doesn't work well is just using a piece of hookup wire. Also, connect all your equipment to the same point, rather than looping the ground braid from radio to radio. That way, you won't have any RF feeding from one rig to the next, which can cause problems.

Ultimately, you may need to do some experimenting to get a good ground. Some locations, like my house, just don't offer many options for a decent ground; I've had feedback problems ever since I moved in. Other places may make grounding easy. If you do have feedback problems causing distortion, hum or squealing in your transmit audio (or making your equipment "hot" to the touch during transmit), at least try using a balanced antenna and perhaps a balun; such measures may eliminate the trouble and make a great ground unnecessary.

All Dressed Up . . .

Finally, we come to an issue many people overlook. The "lead dress," or arrangement of wires, sometimes can matter a great deal. This is particularly true when HF linear amps are used. Try to keep antenna coax away from radios, power supplies and, especially, microphones and mike cables. When I lived in Boston, I had an HF amp. With the amp placed to the right of the rig, and the coax going from the rig to the amp and out the window to the antenna, everything worked fine. But, if I put the amp on the other side and routed its output coax back behind the rig to get to the window, the whole system went nuts every time I keyed up! Even coax can radiate a little bit of a field, especially when you have a kilowatt of RF going through it.

Well, I hope this has helped you to think about some of the issues involved in setting up a ham radio station. Remember, safety first! Until next time, 73 from KB1UM. RF

radio magic

by Michael Bryce WB8VGE

This month, some loose ends need to be tied up and some new projects started. First off, the folded dipole I described several months ago (September 1993) needs some fine-tuning to make it work.

The problem is the tuning stub. I have it shown as one of the shorting stubs. That's not correct. The tuning stub really replaces the small fixed value capacitor in the feedline. Now, why use the tuning stub instead of the capacitor in the first place? By using the tuning stub, you can fine-tune the folded dipole by very carefully adjusting the length of the stub. That's not the case with a fixed-value capacitor. Ceramic capacitors and even silver mica capacitors are not right on the nose when it comes to value. They do have a tolerance that may throw off the dipole's resonate frequency a bit. The tuning stub is not perfect, either. For it to operate correctly, it should be 90 degrees from the feedline. That's hard to accomplish in real life. Also, the wind will whip the tuning stub around, causing the feedline impedance to change. The stub must be mounted so it will not touch any metal objects. This will de-tune the stub and cause the dipole to change its point of resonance. The simplest solution is to just go ahead and use the capacitor and not mess with the stub. Thanks for all who have called or written about my error.

The "Radio Magic" Keyer Project

The small keyer we did last year turned out to be very popular. So popular, in fact, that all the kits are long-gone. While the kits won't be available anymore, you can still get a PC board from FAR Circuits, 18N640 Field Court, Dundee IL 60118, for $5 plus $1 shipping. Ask for the *Radio Magic* keyer board.

Parts Is Parts

When I put the kit together, I used common off-the-shelf parts. I received feedback from several of the kit builders about the markings on some of the parts. This was especially true with the capacitors used in the kit. Why some capacitors are marked 0.1 and some are marked 104 is beyond me. Depending on the company making the parts, the actual values can be very cryptic. I'm not going to go into detail as to the color codes used in today's electronics, but rather I'll condense some of the information down to a usable form.

Ceramic capacitors are the worst offenders. They come in all sorts of styles and have zillions of different ways of being identified. A capacitor marked 104 (104K) is a 0.1. A capacitor marked 103 (103K) is a 0.01. Usually, when the value of the capacitor is low, say 47 pF, the capacitor really is marked 47. You may not see 47 pF, just 47. There may also be an added letter to the markings. Usually a K or J will be shown, along with the value. A common marking would be 47K or J47. I don't know what the extra letter is for.

There may be a colored dot on the capacitor. This dot represents the temperature coefficient of the capacitor. You'll come across a black dot, meaning the capacitor has a negative temperature coefficient. This capacitor is called an NPO type. There are other types, but you'll see this guy in VFO circuits or other tuned circuits that must stay tuned as the temperature changes.

Electrolytic and Tantalum Capacitors

Electrolytic capacitors are marked with their actual values. A 470 µF is normally marked as such. The trouble with these critters is they're polarity-sensitive. They must be installed correctly or they won't work. And, sometimes if you have one in backwards and apply power, they'll explode!

For reasons known only to a select few, the negative lead is usually marked. Each manufacturer uses at least one of several different methods. The most common is to show the negative lead with an arrow pointing down, with an RPS sign running alongside. Sometimes the RPS is shown inside a bold arrow, also pointing to the bottom. Not so common is the R+S sign inside a circle, denoting the positive lead of the capacitor. There's more! The negative lead is shorter than the positive lead.

Tantalum capacitors are also polarity-sensitive, just like their cousins, the electrolytics. You'll see tantalum capacitors in critical circuits that require a high degree of stability from the capacitors. You'll see tantalum capacitors used in timing circuits, oscillators, and control circuits. Their small size makes them perfect for today's miniature electronics. The teardrop shape, combined with their small size, makes them easy to spot on a circuit board. A tantalum capacitor has its positive lead marked with a tiny R+S, usually on the top or bottom of its body.

Both tantalum and electrolytic capacitors will have a working voltage marked on them also. This is the maximum voltage the capacitor can withstand without damage. Although less common, you may see a surge voltage rating listed. You won't see this on the smaller value capacitors—there is not enough room for the print! You'll come across surge ratings on large capacitors typical of power supplies. The surge rating used for most ham projects is something not to worry about. Most electrolytic and tantalum capacitors used in our projects have a working voltage of 25 volts with a surge of 35 volts. That's more than ample for a circuit running on a 9 volt battery or a 12 volt power supply. However, be aware of hamfest bargains! Many times you'll find capacitors with a working voltage of only 6.3 volts and a surge rating of 12 volts.

I have one final note on electrolytic and tantalum capacitors. These stinkers come in two very popular styles. One is called *radial* and the other *axial*. Like a fat women putting on a tight pair of jeans, with a bit of tugging, shoving, and yelling, you can sometimes get the axial style to fit a PC board laid out for a radial package. If you do succeed, the results are nothing to look at, just like the fat women in the tight jeans.

There must be a reason why most of the circuits I've come upon use radial

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capacitors, but I sure don't know what it is. I don't have a single axial cap in my parts bins, but I have thousands of radial capacitors in stock. In real life, if you're building a circuit on perfboard, you can use either style. But, a PC board is designed around a certain size part. You should use the correct part.

So, how do you tell what is what when you're capacitor-trolling at a hamfest? It's simple: A radial capacitor has both its leads coming from the bottom; an axial capacitor has one lead on each end. Just like an axle on a truck, you could put wheels on it. So, just remember you could put wheels on an axial capacitor and not on a radial capacitor.

Solid-State Components

Solid-state devices, such as transistors, ICs, and regulators, are quite different altogether. You'll find, more often than not, that the actual part number is not marked, but rather an industrial number known only to one company. This may be the company's part number. A 2N2222 may have several thousand different part numbers assigned to it. A very common number is PN22. I've seen these show up all the time at hamfests and swap meets. These parts have a tendency to show up in kits as surplus pieces. In a way, there is nothing wrong with using surplus parts in a kit. In fact, the surplus parts are usually of better quality than a part with an honest-to-God number on it.

Many of the surplus parts were to be used for the military and therefore are of very high quality. Industrial parts usually have a higher (or wider) temperature range than the consumer-grade part. Many of the industrial parts also have greater capacity, be it in output current or, perhaps, in RF output. The only real trouble with using these critters is knowing what is what. I have bags full of thingies, with no idea what they are. They look too good to be thrown away, so they stay in the junk box. I have several hundred TOP220 cased *something* like transistors, yet the package they came in says rectifier diodes. I have no idea what they are. I brought them at the Dayton Hamvention several years ago. Got them for 25 cents a pound. It was a great buy!

With some extra time on one's hands, and a good VOM, you can usually find out what lead is what on surplus transistors. You can also tell if the device is PNP or NPN without too much trouble. I don't keep surplus ICs, though. I don't have the money for one of the fancy IC testers and identifiers. Without one of those, it's like peeing in the ocean to try and tell what is what.

Figure 1 shows some of the more common capacitor styles, along with some transistor outlines. You may want to cut this out and keep it for a reference. It may come in handy when you're troubleshooting your equipment.

New Project

If there is enough interest, I'll show you how to build a small QRP (2 watt) transmitter. It's a nice project to get your feet wet in simple RF design. Drop me a note, or send one to the editors (they'll be sure I get it).

Talk to Me

If you have a computer and a modem, and access to one of the on-line services, you can send E-mail to me and save a tree. My CompuServe ID # is 73357,222. My America On-line address is Michae1087. Both of these services have a two-way port to Internet, too. If you're a real sucker for punishment, try the *73* BBS at 1-603-924-9343. Of course, good old-fashioned US mail works in a pinch. RF

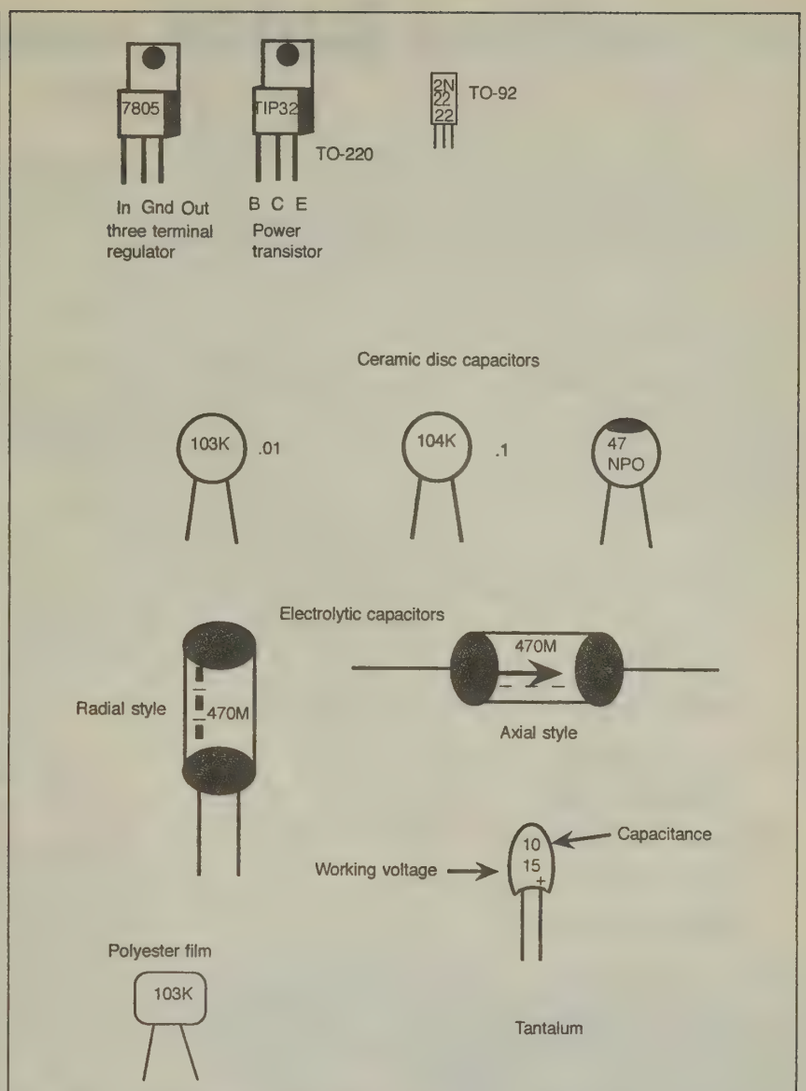

Figure 1. Some common component designs for transistors and capacitors.

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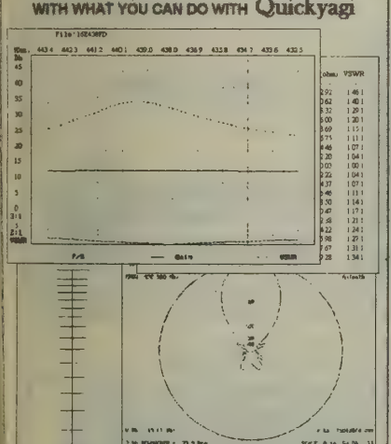

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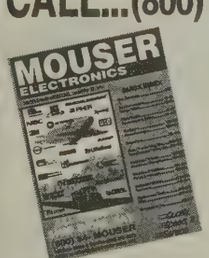

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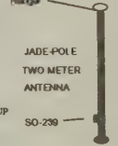

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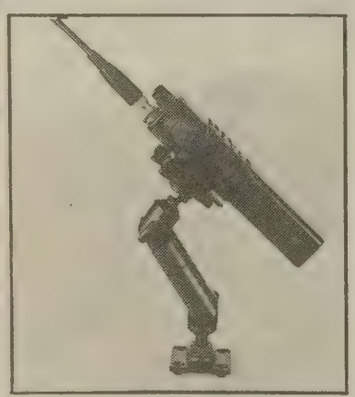

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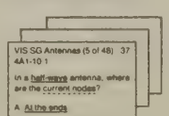

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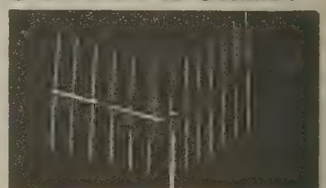

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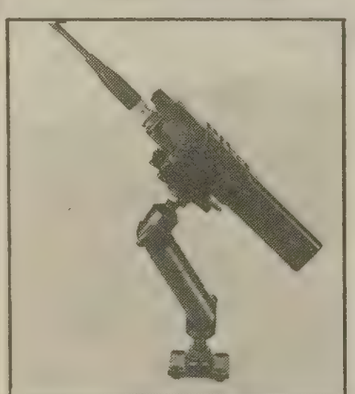

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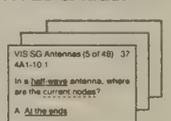

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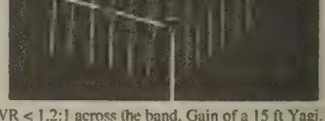

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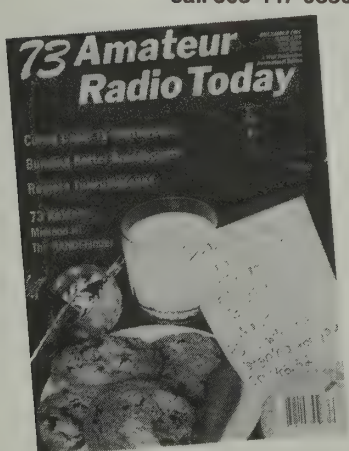

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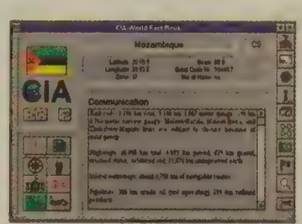

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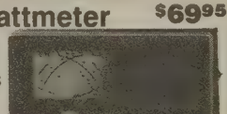

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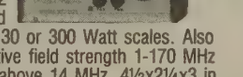

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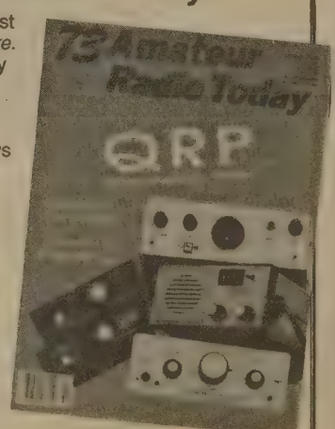

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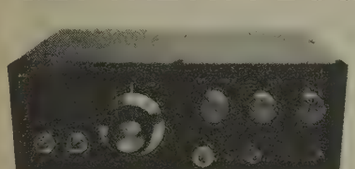

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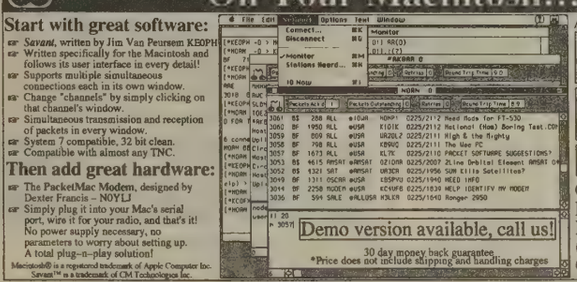

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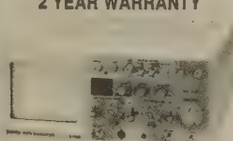

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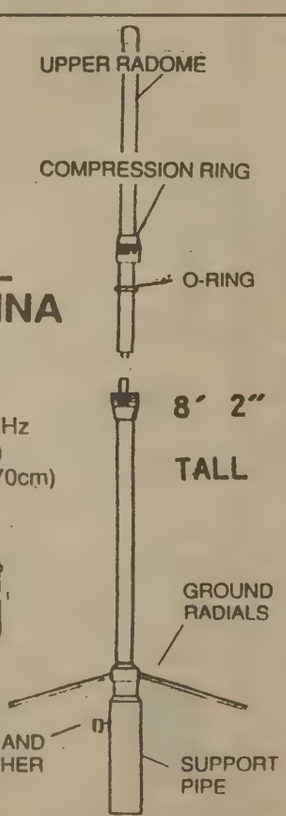

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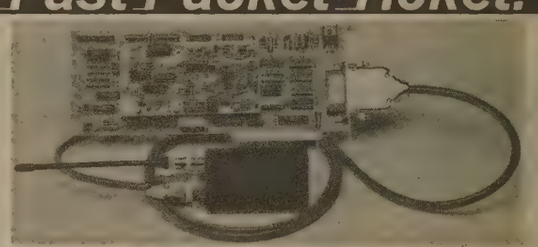

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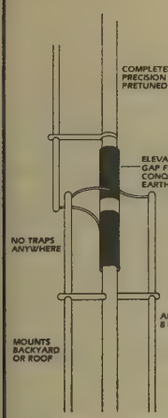

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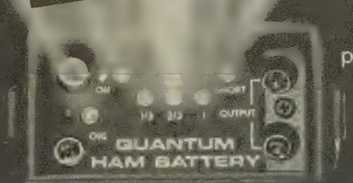

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Price Class: $249.95

MFJ Model 1786

MFJ's Super Hi-Q Loop Antenna.

by Don Johnson K7UGQ

Full-sized antennas are nice if you have the height and space for them. However, much of the advantage is lost with less-than-expert installations. This review deals with a trim, smaller antenna with performance that definitely outperforms full-sized poorly-installed arrays.

Because I have lived on a standard-sized city lot most of my life, I have always been fascinated by small high-efficiency antennas. Verticals, shorter G5RV dipoles, linear loaded beams and mini quads have dotted the skies above my house. I even built my own loop antennas, but soon realized that I didn't have the mechanical talent and shop equipment necessary to ensure success.

The MFJ 1786 is a small transmitting loop antenna offered at a price about a third that of the competition's. As if a lower price is not enough, the MFJ version also offers several bells and whistles, while sporting an advanced frequency controlling technique.

What's a Loop?

To better appreciate the benefits of a small loop antenna, a short discussion on their makeup may be warranted. For the purpose of this article, we can describe the small loop as a one-turn inductor whose circumference lies somewhere between 1/3 and 1/8 wavelengths of the desired frequency. If a variable capacitor is inserted in parallel with the inductor, this L/C combination can be made to resonate. Theoretically, a small loop antenna does not need to be elevated above ground as other antennas do. In fact, small loops can work very well indoors. Loops that are bigger than 1/3 wavelength will self-resonate and act electrical, not magnetic as the small loop does. Quad and delta antennas are electrical antennas since their circumferences are greater than 0.33 wavelengths. Because of this, electrical antennas must be elevated to obtain any level of efficiency.

What's Inside

The approximately 2-foot by 3-foot box contained a fully assembled 36" loop antenna, a heavy-duty mounting arm, some attachment hardware, a 17-page full-sized manual and the electronic control box. The 1.050" tube exhibited tooling marks (scoring) that distracted from an otherwise nice appearance. These marks will not affect performance; however, they can sometimes be an indicator of other workmanship concerns. Disassembly of the antenna and the control box did not uncover any sub-standard workmanship or quality of product, however.

The manual, though not "fat," does contain sufficient assembly information, a little bit of theory and an excellent warranty. In fact, warranty item 4 states in part, "This warranty is NOT void for owners who attempt to repair defective units . . ." A technical phone number is provided for assisting in repairs. This attitude is definitely world-class—it puts the customer first. More and more, the better companies are allowing owners latitude in repairing defective equipment.

Set-Up and Installation

A quick read of the manual reveals that the mounting arm is only required if the antenna is to be mounted horizontally. Vertical mounting requires no mounting bracket.

Your first 30 minutes or so will be spent trying to decide which way to mount the antenna. Hint: If the mounting height is less than 20 feet, vertical is your choice. Anything over 20 feet should be horizontal. Vertical mounting offers a low angle of radiation, good for DX, while horizontal mounting provides a full omni pattern with very low noise capture.

MFJ took a page from remote antenna switch manufacturers by eliminating the need for a control cable. Low-level DC control voltage is applied to the tuning capacitor linear motor through the coax line. At the antenna, a decoupling scheme removes the control voltage and applies it to a motor/gear train combination for control purposes. The lack of a control cable greatly simplifies the installation process.

To assist in tuning, the control box contains a cross-needle SWR/wattmeter that reads forward and reflected power on high and low power scales. Sophisticated electronics, similar to electronic peak-and-hold circuits, are also employed to assist the critical tuning process. Once a steep dip in SWR is reached, the motor system shuts down, awaiting fine-tuning by the operator. The coarse- and fine-tuning coupled with different-colored LED indicators provide positive and precise control. A red or green LED notifies the operator which way to fine-tune, up or down in frequency. Since the antenna capacitor is isolated from the motor by a gear train, you must always take into account inertia when toggling through the fine-tune position. The faster you move the motor, the more inertia is generated, almost guaranteeing overshoot. Practice will develop the touch necessary to "break" prior to the SWR dip.

While installing the coax to the control head, I noticed a rattling noise inside. Removing the cover revealed an empty battery holder for "AA" size batteries. This allows true mountain topping portable (battery) operation. Another nice touch.

On-the-Air Tests

The bottom line for any piece of ham gear is its performance. This antenna works. Works as good as, and often times better than, my vertical. Both of my antennas are roof-mounted, 30 feet in the air. The first thing you'll notice with the loop antenna mounted horizontally is the low noise level, regardless of the band. This characteristic alone can improve the signal reception capability by one or more S-units.

During a recent weekend contest on 20 meters, most European stations gave me 1 to 2 S-units higher when using the vertical. However, dead-band ground-wave testing on 10 meters provided loop readings of 1 to 2 S-units over the vertical.

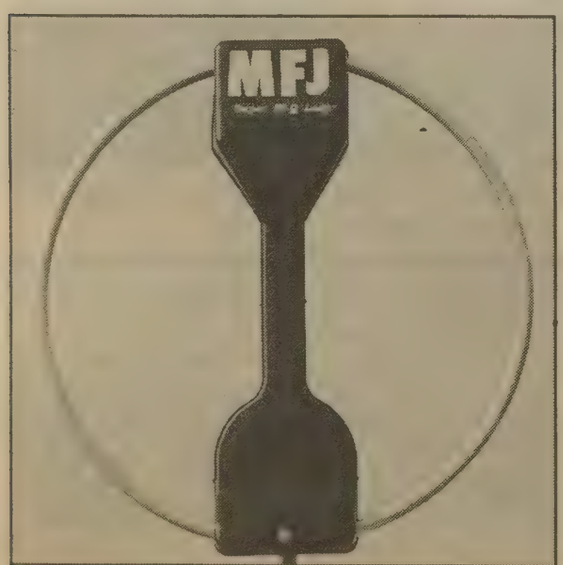
Aside from the inordinate wait to buy one, the only real negative with this antenna centers around its slow tuning process. Coarse and fine "UP" and "DOWN" frequency controls, coupled with the cross-needle watt/SWR meter, assist the process. However, up to one full minute can be spent retuning the antenna after a frequency change. Thus, this is not the best antenna for contest QSYs.

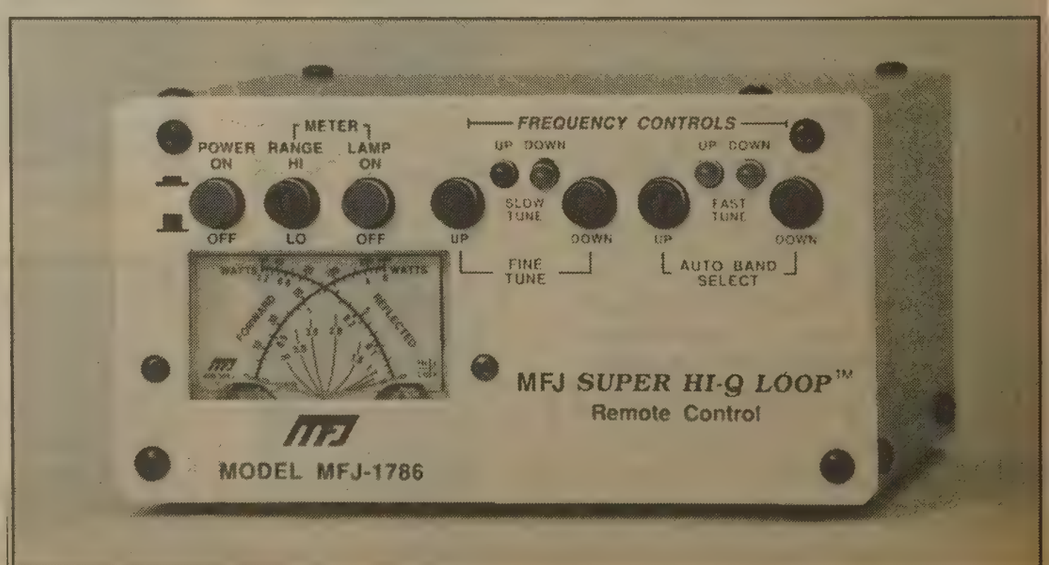
Anyone operating on the HF bands between 10 and 30 MHz could benefit from a small transmitting loop. Moreover, those who live in areas with antenna restrictions, apartments, and RVs would benefit the most from the MFJ Super Loop.

MFJ sells a version of the Super Loop (Model 1782) without the meters and sophisticated tuning arrangement. A coarse, slow/fast button controller version sells for $219.95. RF

Specifications

Nominal Impedance	50 ohms
Frequency Range	10-30 MHz
Max Power Handling	150 watts
VSWR (2.5:1 points)	30 kHz
Circuit "Q"	500 to 2500
Dimensions	36"/20 lbs
Max Mast OD	1.5"
Coax Connector	SO-239





The MFJ Model 1786 Super Hi-Q Loop Antenna.

antennas, etc.

by Joseph J. Carr K4IPV

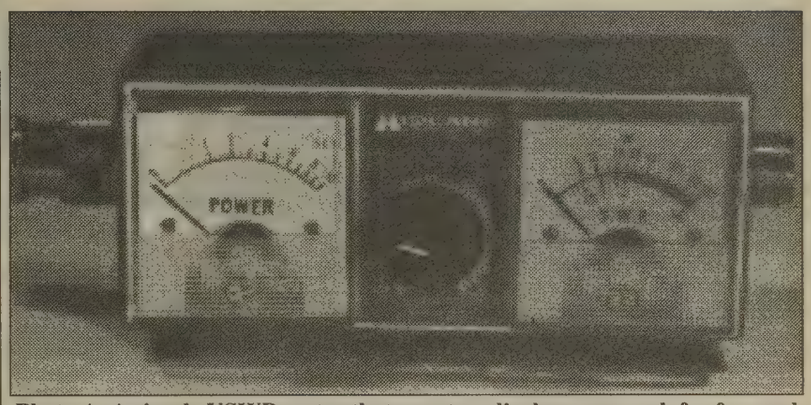


Photo A. A simple VSWR meter that uses two displays, one each for forward and reverse directions.

RF Wattmeter, VSWR Meter or SWR Analyzer?

The RF wattmeter and the VSWR meter are among the most popular station accessories sought by radio amateurs everywhere. The former measures the RF power in a transmission line in watts or milliwatts (or, if you are the Voice of America, megawatts), and may include the ability to measure power in either the forward (to the antenna) or reverse (reflected from the antenna load end) direction. The VSWR meter measures the voltage standing wave ratio of the antenna, and may or may not be calibrated in watts.

Which meter to select depends on what you want to do with it. If your only goal is to check your antenna VSWR or adjust an antenna tuning unit (ATU) for the proper point, then a VSWR meter is sufficient. The generally higher cost of a meter that is reliably calibrated in watts is not justified. But if you want to measure RF power, or if you operate close to the legal limit (in which case you are well advised legally to use a reliable RF wattmeter), then you will want to use an RF wattmeter.

A number of different types of both RF wattmeters and VSWR meters are available to the radio amateur operator. Photo A shows a type of VSWR meter that I first saw in connection with Citizen's Band in the early 1960s, but has since become a staple in ham radio. It is a small unit and is ideally suited for QRP and medium power transmitters. While it will work up to the full legal limit, the sensitivity control is at its minimum, and that sometimes (in my experience) makes it a bit touchy to find the correct setting.

The unit of Photo A has two meters. The left-hand meter is marked "POWER" and the right-hand meter is marked "SWR." However, the POWER meter is really a relative power meter; i.e. it will deflect upward when the power goes up and downward when the power goes down, but does not measure watts with any degree of reliability. Some of these instruments had a dot marked on the sensitivity control dial that would supposedly calibrate the power meter to some specific level (like 5 watts), but that always proved to be more than a tad inaccurate.

The way the VSWR meter shown in Photo A operates is similar to a large class of instruments: a low-power transmitter set to the desired frequency is turned on to excite the antenna. The POWER meter will deflect upscale (and may peg). Adjust the sensitivity control to produce an exactly full-scale deflection (not pegged, but the pointer is set to either a special mark—"SET"—or the highest tick on the power scale). When the POWER meter is so adjusted, the SWR meter will read out the VSWR.

> ***"Which meter to select depends on what you want to do with it."***

In actuality, both POWER and SWR are relative power meters, but the SWR meter is connected in the reverse direction, while the POWER meter is in the forward direction.

There are a number of different RF wattmeters on the market, and most of them are pretty good. You will find several models advertised in this magazine as well as in *73 Amateur Radio Today*. Also, check out the catalogs of the major mail-order ham radio equipment dealers.

Photo B shows my favorite RF power meter: the Bird Model 43 Thruline. It can be left in the transmission line while operating, or used to make specific measurements on an ad hoc basis. The Model 43 has the basic instrument which contains the meter, the coaxial connectors and an internal transmission line sensor. A set of plug-in elements are used to customize the Model 43 to a specific frequency range and power level. The element is the round object with the arrow on it below the meter. Most Model 43 owners have two more elements to match their operating requirements. The direction of the power being measured is indicated by the arrow on the element, which can be rotated to measure either forward or reverse power.

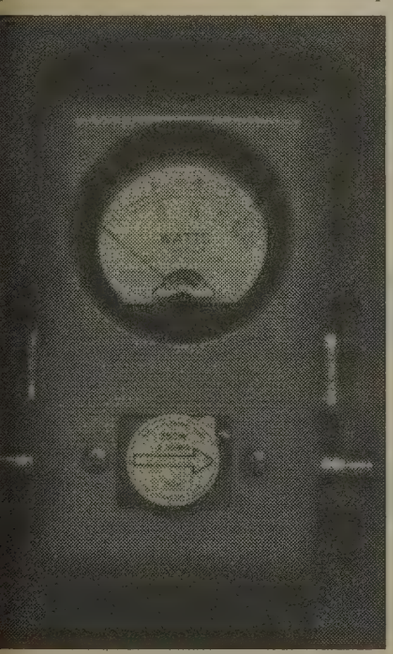


Photo B. Professional-grade RF wattmeter.

In the latest Electronic Equipment Bank catalog (323 Mill St. NE, Vienna VA 22180; Phone 703-938-3350 or for orders 1-800-368-3270), the Model 43 is priced at $230 for the RMS power model, and $325 for the peak reading model preferred by single-sideband operators. The elements sell for $61 to $110, depending on frequency range and power level combination.

Operators who use hand-held VHF transceivers may be interested in a combination dummy load/RF power meter, shown in Photo C. This instrument has a BNC connector on one end to match the usual hand-held antenna output connector.

An alternative to the Model 43 and other single meter instruments is the cross-needles type of meter. Daiwa offers several models from around $82.95 for a mobile model (EEB catalog) to about $185 for a peak reading remote model. The cross-needles meters are available in both RF power and VSWR models. They use a single meter assembly that has two movements, one each for forward and reverse power. The idea is to minimize the reverse power and maximize the forward power.

If you don't use an antenna tuning unit (shame on you) but you want to be able to test the antenna VSWR, then you may wish to opt for neither of these instruments. In those cases, the MFJ Enterprises (Box 494, Mississippi State, MS, 39762; phone 601-323-5869, or for orders or nearest dealer 1-800-647-1800) series of VSWR analyzers are a better bet. Those instruments contain a very low power RF signal generator that allows these sensitive instruments to "wring out" an antenna without exciting it with the transmitter. The advantages of these instruments include not interfering with other amateur operators using the band being tested (which is both a legal requirement as well as ol'-fashioned good manners).

By the way, the RF power meter can be used to measure the VSWR as well as power. The formula is relatively simple and can be found in any decent antenna book, such as the *ARRL Antenna Book*, the *ARRL Handbook for Radio Amateurs*, or my own *Practical Antenna Handbook* (TAB 3270; 1-800-233-1128 for orders).

The SWR analyzer also makes it possible to find the resonant point of an antenna that is so mistuned that it is out of band. One 15 meter dipole that I built was mismeasured (no doubt about it, I cut it too #$%## long), and resonated at 19.34 MHz. That frequency is not legal for me to operate on, so if I was solely dependent on the RF power meter or transmitter-excited VSWR meter, I wouldn't have known how far off resonance it was, or in which direction.

These various meters accomplish some of the same goals, and which one you use is sometimes a matter of preference. However, they offer just enough different services that I opt to own all of them. RF

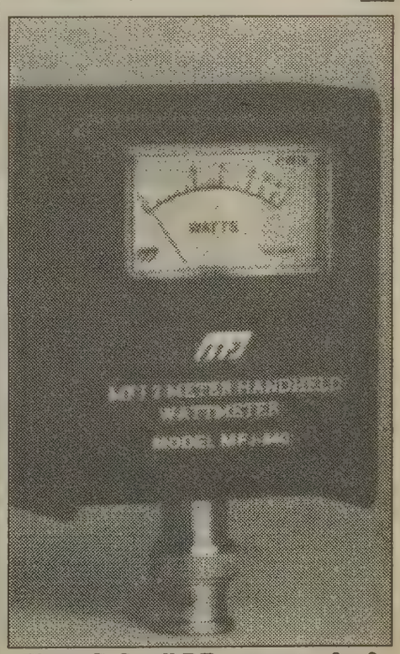


Photo C. Small RF wattmeter for 2 meter handhelds.

upgrade... don't stop now

by Gordon West WB6NOA

Photo A. An Ameco engineer testing for gain and selectivity.

Soup Up Your HF Set

An interesting thing happened when SSB high frequency transceivers went from tubes over to transistors, and then compartment-type circuitry changed to small surface-mount technology (SMT) stand-up boards—sensitivity went up. But out-of-band selectivity has now become an important consideration.

Case in point: I have a good working Kenwood TS-520. Receiver sensitivity is good, and selectivity is great after I tune the plate, load, and grid controls. I can work stations at the top end of 20 when the ham down the street runs CW at the bottom end of the band. I also don't have problems from the nearby AM broadcast station showing up several places on the dial when I'm down on 75 meters and 160 meters.

My brand-new state-of-the-art transceivers no longer require dipping the plate and adjusting the load and grid controls. Their broadband receiver lets me hear everything from 500 kHz to 29.99 MHz. The receiver is hot as a firecracker, so sensitivity has never been better. But, down on 20 meters I can't operate on the same band as my neighbor down the street without interference. However, this is understandable—we are only separated by about 800 feet. And with the newer sets, operating near a powerful AM broadcast station will sometimes bring in music and talk shows I don't want to hear on 75 and 160 meters.

The Ameco PT-3

I found a quick and powerful cure for any HF transceiver that needs added sensitivity with increased selectivity. The product is over 15 years old, and comes from the venerable Ameco Corporation (Mineola, New York; 516/741-5030; Model #PT-3). "This box simply plugs into the antenna jack of any HF set and adds the potential of 20 dB gain to an older set or QRP unit that needs better receiver sensitivity, and up to 40 dB attenuation of out-of-band signals," comments Jim Lyons N2WSN, Vice-President and Senior Engineer for Ameco.

"The RF amplifier is a dual-gate, low-noise, field-effect transistor, and the tight selectivity is achieved by manually switching in the band selector for the right inductance and tuning a variable capacitor for an optimum L/C combination with extremely deep skirts," adds Lyons.

The PT-3 covers 1800 kHz all the way up through the 6 meter band. The field-effect transistor preamp is adjustable so as not to swamp the sensitive receivers of the modern ham set.

Adjust as much gain as you want via the front panel knob. We found that about 10 dB of gain was just right for our older tube-type equipment and the new breed of QRP transceivers. The PT-3 includes automatic switching as soon as it detects output power. A red LED indicates the unit is in the "through" transmit mode, and the green LED comes on indicating it is in the receive mode for added sensitivity and selectivity. We measured transmitter insertion loss as less than 0.14 dB at 28 MHz.

A delay control keeps the relays from chattering when operating CW and SSB. There was plenty of latitude in the setting to give us either a short delay or a long delay. You would NOT use this set-up for CW QSK operation; it won't switch fast enough. But for sideband or semi-break-in CW, the delay is identical to the adjustable VOX delay on your HF transceiver.

During our tests, the added selectivity to attenuate the problems of the nearby ham and the big AM radio station a few miles away were indeed noticeable. By fine-tuning the variable capacitor and making small adjustments of the gain control, you could come up with an ideal setting where you could actually hear the difference when you switched the unit in and out of circuit on the same antenna system. On older radios that needed increased receiver sensitivity, the 20 dB amplifier makes one heck of a difference.

"The gain and tune controls can be used to improve strong local reception so that these signals tune sharper and fall off more rapidly on the band," adds Lyons. And during a tour of the Ameco facility, I quickly learned that Ameco is a recognized industry leader in the commercial filter and amplifier market. The ham radio side of Ameco is just a very small part of their highly technical filter engineering division.

The PT-3 works off of 12 volts, so come up with your own DC power or use one of those wall adapters observing the proper polarity with the power adapter sleeve as negative. The units sell for under $150, and sometimes you can see them at ham swap meets for as little as $50 if the selling ham doesn't realize the ultimate capabilities of this setup.

If your present HF system is working nice and sensitive with plenty of selectivity, you don't need it. But if you live near powerful AM or shortwave broadcast stations, or have a ham or CBer just down the street, it very well could help increased out-of-band selectivity by at least 40 dB, and this could be enough to clear up any hash that may be coming down on your favorite HF frequency. Although you must manually adjust the knobs every time you change bands or make big frequency excursions, it helps you tune in exactly what you want, and helps minimize out-of-band interference RF

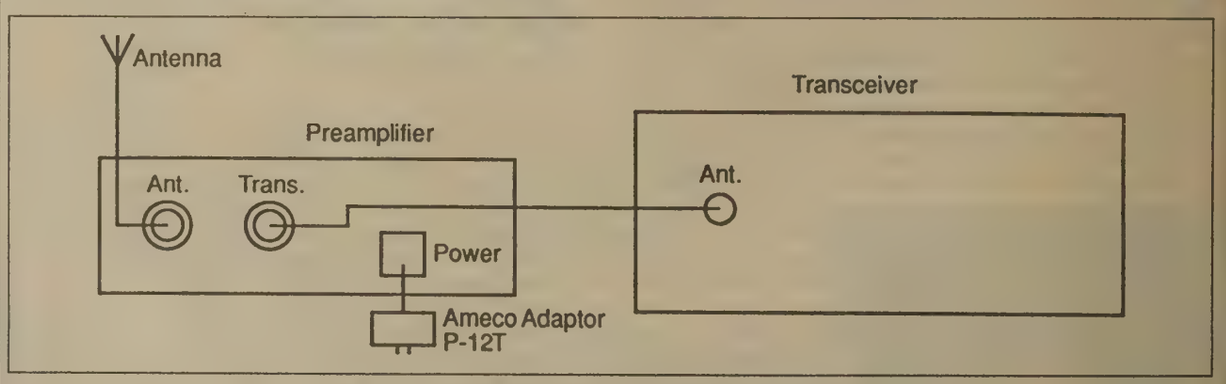


Figure 1. Installation of the PT-3 with transceiver only.

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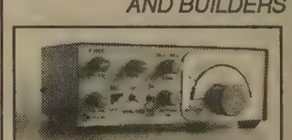
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what's next?

by Carole Perry WB2MGP

Full of Hot Air

If you participate in the "CQ All Schools" net on Tuesdays and Thursdays at 17:30 UTC on 28.303 MHz, you already know of our intense interest in Project Earthwinds. *[Editor's note: At press time the project was scheduled for a January 5, 1994 launch date.]* Gordon West WB6NOA has been keeping us informed on the development of this first-ever manned baloon flight around the earth. As the balloon follows the jet stream, world-wide 2 meter ham radio contacts will have been made.

Photo A. Sixth-grader Dean builds a mini space station in the "resource" section of the classroom.

After one of Gordon's announcements about Project Earthwinds he asked my sixth-graders if they knew what happened to the air when it gets pumped into a tire with a bicycle pump. It didn't take long for me to realize that this was a good time to "launch" a unit on air. When using amateur radio as a motivational tool in the classroom, I find that the best lessons are the ones that come about in an impromptu manner as a result of a conversation on the air. The topics are relevant to what the children are immediately involved with, and this is a terrific way to learn.

First we discussed the properties and characteristics of air. We all breathe in air every day of our lives, but most of the time we don't notice the air all around us. We made a list on the board of all the ways we could show the existence of air. For example, the students knew that air is visible when bubbles are produced underwater, or that wind is an example of air in motion. We went on to discuss that when air is heated, it becomes lighter, and rises. That's why mom tells you not to sit on the floor on a cold day.

Birds and gliders use rising currents of warm air to float in the sky. When air moves, it has enough power to push sailboats along and to drive windmills. When air is compressed into a small space it has great strength. The compressed air in a bicycle or car tire supports the weight of that vehicle, and compressed air also helps a helicopter to rise up into the sky.

Because the children seemed genuinely interested in learning more about air, I borrowed several appropriate books from the library, and gathered additional science textbooks from several science teachers. I arranged the books in an attractive display on our research table in the rear of the room where the kids have easy access. I always have plenty of paper and pencils available for them to use during their research time. The students cooked up a series of interesting experiments based on their readings. Here are some of the fun things we did in this unit:

1. Air takes up space, but hot air takes up more space than cold air. You can prove this for yourself. The equipment you'll need include a plastic bottle, a balloon, a deep bowl, some hot water, and some ice. First, fit the balloon over the mouth of the bottle. Then stand the bottle in the bowl and fill the bowl with hot water. After a few minutes the balloon will start to inflate. Ask the children what they think will happen if you tip the water away and fill the bowl with ice. Let the students evaluate their predictions with what really happens when you do it.

2. Some of the students blew up balloons as hard as they could. Then they placed them on top of the hot air ducts in our classroom. The bursting sounds that followed in a few minutes made the point of hot air expansion.

3. The kids did research on hot air balloons in preparation for Earthwinds. We learned that when balloons are filled with hot air they become lighter than the air around them and float up into the sky. Modern hot air balloons have a gas burner to heat the air inside them. The wind blows the balloon along. Many balloons are filled with helium; a gas which is lighter than air. Balloons can be used for a variety of services, ranging from advertising to carrying scientific instruments high up into the atmosphere. The Earthwinds Project was designed to collect weather and other atmospheric information for NASA and other national weather organizations.

4. To make a hot air balloon in the classroom you'll need four sheets of heavy tissue paper rectangularly shaped and one sheet in a square shape. Glue the short sides of the rectangles to each side of the square. Glue together the long sides of each rectangular sheet to make a balloon shape. Inflate the balloon with hot air from a hair dryer and watch it float up to the ceiling.

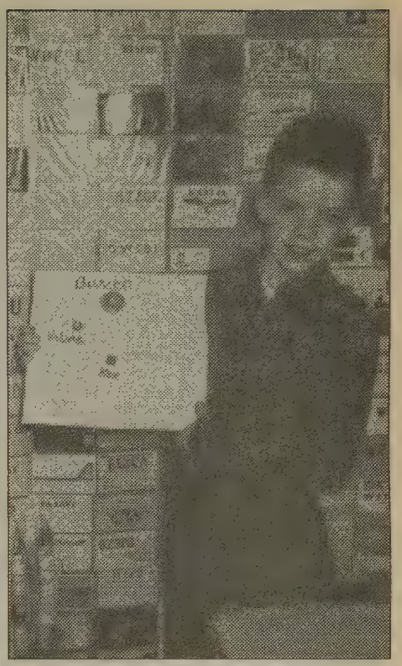

Photo B. Sixth-grader Jack works on his electronic buzzer project in the "resource" area.

Some of the books we used in the class were: *Elementary School Science* by Blough, Schwartz, and Huggett, *Space and Astronomy* by Bonnet and Keen, and *175 Science Experiments* by Brenda Walpole.

Dayton Youth Forum

It's that wonderful time of the year again! I'm beginning to interview youngsters for the Youth Forum at Dayton. If you know any boy or girl under the age of 18 who would like to participate in the forum by sharing their ham radio experiences with us, please have them contact me at (718) 983-1416 or at P.O. Box 131646 Staten Island, NY 10313-0006. RF

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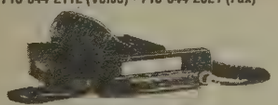

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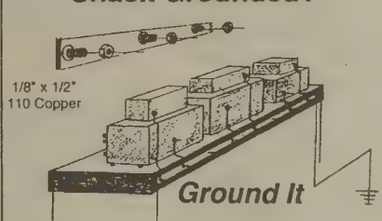

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Radio Fun flea market

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 30,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar, and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *Radio Fun Flea Market* costs you peanuts (almost)—comes to 25 cents a word for individual (noncommercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, Judy Walker, 70 Route 202 N, Peterborough NH 03458, and *get set for the phone calls.*

The Deadline for the April 1994 Flea Market is January 13, 1994.

SENSATIONAL NEW WAY TO LEARN CODE- Do Aerobics, Sing, Jog, or **Drive** while learning code! **Now** the secret is yours! Order **THE RHYTHM OF THE CODE-Morse** code music cassette today! $9.95 ppd **KAWA RECORDS.** P.O. Box 319-R, Weymouth MA 02188. The **HIT** of the 1993 Dayton Hamvention! RF247

MINIATURE POLICE RADAR TRANSMITTER one mile range. $41 assembled. $31 kit. (219)489-1711. P.O. Box 80096, Fort Wayne IN 46898. RF251

AMIGA, MACINTOSH, ATARI XL/XE/ST Amateur Radio PD Software $4.00 disk. Two-stamp SASE brings catalog. Specify computer! **KINETIC DESIGNS HAMWARE** Box 1646, Orange Park FL 32067-1646. RF266

QSL SAMPLES- 50 cents. **SAMCARDS,** 48 Monte Carlo Dr., Pittsburgh PA 15239. RF275

IBM SHAREWARE! Huge selection! $1.00 Disk! 35 cent Specials! Catalog $1.00. **PMA-RF.** Box 2424, Scottsdale AZ 85252. RF360

CUSTOM MADE-HAND TOOLED Leather products with your initials, name, call letters. Photo's & estimates available. Key rings, wallets, belts, purses, hanging signs, specialty items. GREAT GIFT. **LEATHER & WEST,** 67 Causeway Rd., West Swanzey NH 03469. (603)352-6256. 9-4 pm. M-F ET. RF370

KIT BUILDERS! Complete list of 155 + kit vendors. #10 SASE + $3 USD to: **RUTENBER ENGINEERING.** 38045 10th St. E. #H75-RF, Palmdale CA 93550. RF485

INEXPENSIVE HAM EQUIPMENT. Send stamp for list. **WA4DSO,** 3037 Audrey Drive, Gastonia NC 28054. RF559

PRINTED CIRCUIT BOARDS for *73 Magazine, QST, ARRL Electronics Now, Nuts & Volts,* projects. U.S. orders deduct 20%. Free list. **B-C-D ELECTRONICS,** Box 20304, 858 Upper James St., Hamilton, Ontario, Canada L9C 7M5. RF585

PRINTED CIRCUIT BOARDS for projects in *73, Ham Radio, QST, ARRL Handbook.* List, SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118. RF595

THE MODULATORS MATCH RADIO TO AMP. All kits will greatly increase your modulation while suppressing the carrier. GRANDMA MOD fits RCI2950. GRANDPA MOD fits HR2510. ONLY $19.95 ea. (800)536-0109. Dave. RF615

WANTED: BUY & SELL All types of Electron Tubes. Call (612)429-9397. Fax (612)429-0929. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. RF620

INTERESTED IN PUBLIC SERVICE? Join REACT TODAY! For information write. **KA3PDQ, c/o REACT,** P.O. Box 8797, Allentown PA 18105. RF630

VHF-UHF-SHF Large SASE. **VHFer** P.O. Box #685, Holbrook AZ 86025. RF660

RADIO TRANSCRIPTION DISCS WANTED. W7F1Z, Box 724, Redmond, WA 98073-0274. RF700

9 1/2 INCH UTC WALL CLOCK- $26.50 ppd. GABAY TOOL CO., P.O. Box 68, Necedah WI 54646. RF705

JOIN TAPR-TUCSON AMATEUR PACKET RADIO (non-profit developers of the TNC). Membership benefits include: supporting the development of new communications technology, quarterly newsletter, low-priced software/shareware, 10% discount on kits and publications. $15/year US and possessions, $18/year Canada and Mexico, $25 elsewhere. US funds. Visa/MC accepted. Bonus: Mention Radio Fun, receive TAPR Packet Radio General Info booklet ($7 value)! P.O. Box 12925, Tucson AZ 85732. RF785

FREE Ham Gospel Tracts. SASE. **N3FTT,** 5133 Gramercy, Clifton Heights PA 19018. RF960

SECRET SCANNER Frequencies: Federal, Police, Aero, Military, Cellular, Surveillance, also SWL & CB Books. Big FREE catalog! **CRB RESEARCH,** Box 56-RF, Commack NY 11725. RF996

activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

FEB 5

CHARLESTON, SC The 21st annual Charleston Hamfest/Computer Show will be hosted by the Charleston ARS at Charlestowne Landing State Park, from 8:30 AM-4 PM. Talk-in on 146.79- or 145.25-. VE Exams at 12 noon - Talk-in on 145.25- to get location. Walk-ins only. For Exams, contact *Ed KC4OOZ, (803) 871-4368; or Warren W4ZYZ, (803) 572-1164.* Flea Market Contact: *Jenny Myers WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814.*

FEB 13

MANSFIELD, OH The Mansfield Mid*Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds beginning at 7 AM. Talk-in on 146.34/.94 (W8WE). For tickets/info contact *Pat Akerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905. Tel. (419) 589-7133 after 4 PM EST.* Send SASE with payments or inquiries by mail.

VANCOUVER, B.C., CANADA The Burnaby ARC will host their annual Flea Market at the Westminster Armouries, 6th St. at Queens, New Westminster BC. Doors open for sellers at 0900 hrs; buyers 1000-1400 hrs. Talk in on 145.35 (VE7RBY), or 442.85. For info, contact *the club net, Monday nights at 2000 local time on 145.35*; or write *Burnaby ARC, Box 72012, 4429 Kingsway, Burnaby B.C. V5H 4P9, Canada.*

FEB 19

SALEM, OR The Salem and Oregon Coast Emergency Repeater Assns. will co-sponsor the 1994 HAM FAIR, beginning at 9 AM at the Polk County Fairgrounds. Talk-in on 146.26/.86. For info write (with SASE) to *Salem Repeater Assoc., P.O. Box 784, Salem OR 97308.*

FEB 20

BRIGHTON, CO The Aurora Repeater Assn. will hold its 12th annual Swapfest at the Adams County Fairgrounds at 9755 Henderson Rd, from 8:30 AM-2 PM. Contact *Judi WD0HNP, (303) 450-6910,* or *Jan KA7TYU, (303) 699-1944*; or write (with SASE) to *Aurora Repeater Assn., P.O. Box 39666, Denver CO 80239.*

CUYAHOGA FALLS, OH St. Vincent's Bingo Hall, 3479 State Rd., is the site for a HAMFEST being sponsored by the Cuyahoga Falls ARC. Contact *(216) 929-4267*, or *Carol Hervol N8JLQ, 11192 Cottingham Circle NW, Uniontown OH 44685. Tel. (216) 497-7047.*

FEB 26

BISMARCK, ND The Central Dakota ARC will hold its annual Hamfest at the Radisson Inn, 800 South Third St., from 8 AM-4 PM. Talk-in on 146.85/.25. VE Exams. Ham/Computer Swapmeet. Get details from *Tim N0SDB, (701) 663-6620*; or *Chris N0POK, (701) 663-1324.*

JENSEN BEACH, FL The Stuart Outdoor Hamfest, sponsored by Martin County ARA, will be held at Langford Park, S.R. 707, at "The Arch," from 0800 UTC-1500 UTC. Talk-in on 147.060 (+600 MHz). Packet Demo. ARRL VE Exams begin at 9:30 AM (courtesy of Ft. Pierce ARC). Sign in at 9 AM. Contact *MCARA, P.O. Box 1901, Stuart FL 34995*; or *Bob Hess KA3EDL, (407) 546-4353.*

LEBANON, PA A Hamfest/Computer show will be held at Lebanon Fairgrounds starting at 8 AM. Sponsor: Appalachian ARG. VE Exams at 9 AM (pre-registration requested). Talk-in on 146.04/.64. For reservations, send check with SASE to *AARG, 105 Walnut St., Pine Grove PA 17963; (717) 345-3780*, or *Lanny Hoffman KD3TS, 337 N. 19th St., Lebanon PA 17042; (717) 274-2148.*

FEB 26-27

CINCINNATI, OH The ARRL Great Lakes Div. Convention 1994 will be held at the Cincinnati Gardens Exhibition Center, 2250 Seymour Ave. Exhibits open at 8:30 AM Sat. and Sun. Commercial vendors and Flea Marketeers are welcome. Convention Chairman: *Stan Cohen WD8QDQ, 2301 Royal Oak Ct., Cincinnati OH 45237; (513) 531-1011.* Vendor Chairman: *Joe Halpin W8JDU, 11615 Geneva Rd., Cincinnati OH 45240; (513) 851-1056.*

FEB 27

DEARBORN, MI The Livonia ARC will hold its 24th annual Swap'n Shop from 8 AM-4 PM, at the Dearborn Civic Center. Talk-in on 144.75/5.35 and 146.52 simplex. VE Exams will be given in the afternoon of the Swap. For info, send 4x9 SASE to *Neil Coffin WA8GWL, Livonia ARC, P.O. Box 2111, Livonia MI 48151. Tel. (313) 427-3905.*

MARCH 5

ABSECON, NJ The Shore Points ARC will sponsor its 12th annual hamfest, "Springfest '94," at Holy Spirit H.S., Rte. 9, 1/2-mi. south of Rte 30. Doors open at 9 AM (7 AM for sellers). Talk-in on 146.385/.985. Contact *SPARC, P.O. Box 142, Absecon NJ 08201.*

DENVILLE, NJ The annual North Jersey Hamfest, sponsored by Split Rock/West Morris, will be held on Morris Ave. starting at 8 AM (sellers 6 AM). VE Exams at 9 AM sharp. Sign up by 9 AM. Talk-in on 146.985 and 223.86. Contact *Bernie WB2YOK, P.O. Box 251, Flanders NJ 07836; (201) 584-4423.*

MARCH 6

NORTHAMPTON, MA The Smith Vocational School on Rte. 9 has been choosen as the site for the 10th Annual MTARA Amateur Radio Flea Market. This event will be presented by the Mt. Tom Amateur Repeater Assn. Inc., starting at 9 AM (8 AM for vendors). ARRL VE Exams at 10 AM. Vendor Reservation Contact: *Jim K1MEA, (413) 527-3199 eves. before 2200 EST.* VE Exam Registration: *Jim WA1ZUH, (413) 245-3228*; or *@ MTMBBS via packet.* Advanced registration strongly recommended.

MARCH 11

ST. LOUIS, MI The Jefferson Barracks ARC will hold their 34th annual RADIO AUCTION at Concordia Turner's Hall, 6432 Gravois, in south St. Louis City. Doors open at 5 PM and the auction starts at 7:30 PM. Talk-in on 146.34/.94, 144.61/145.21. Contact *Vivian WI0EMS, or Scotty KA0FJA, 4121 Fabian Dr., St. Louis MO 63215. Tel. (314) 631-4068.*

MARCH 12

COLBY, KS The Trojan ARC's 1st annual Swapfest will be held from 9AM-5 PM CST at the Colby Nat'l. Guard Armory on K-25. VE Exams March 11th at 6:30 PM at Sirloin Stockade. Early-bird dinner. More. Contact *TARC, Box DX, Colby KS 67701.*

MARCH 13

BRISTOL, CT The Insurance City Repeater Club will hold its annual Hamfest and Computer Flea Market from 9 AM-1 PM at Bristol Eastern H.S., King St. (RT 229). Talk-in on 146.88, and 224.80. VE Exams by preregistration only. Write ICRC, P.O. Box 165, Pleasant Valley CT 06063. SASE required. Flea Market contact: Chuck Motes K1DFS, 22 Woodside Ln., Plainville CT., (203)-747-6377.

INDIANAPOLIS, IN The Indiana Hamfest/Computer Show will be held by the Morgan County Repeater Assn., starting at 8 AM, at Indiana State Fairground's Pavilion Bldg. Advance reservations recommended. Talk-in on 145.25. Contact Aileen Scales KC9YA, 3142 Market Place, Bloomington IN 47403. Tel. (812) 339-4446.

MARCH 14-17

TORONTO, CANADA The International Symposium on Digital Audio Broadcasting (DAB) "The Sound of 2000" will take place at the Sheraton Centre Hotel and Towers. Contact *DAB Symposium '94, 126 York St., #401, Ottawa, Ontario Canada K1N 5T5. Tel.: (613) 594-8226; FAX: (613) 565-2173.*

MARCH 15-17

VISALIA, CA The 1994 Internat'l DX Convention will be presented at Holiday Inn-Plaza Park by the Southern California DX Club. Pre-registration deadline March 15. For info contact *Don Bostrom N6IC, (818) 784-2590 or (310) 334-8717.* For lodging: *Holiday Inn, (209) 651-5000; The Raddison Hotel, (209) 636-1111; the Lamplighter Hotel, (209) 732-4511.*

MARCH 19

MOREHEAD CITY, NC VE Exams will be administered by the Carteret County ARS at First Presbyterian Church Fellowship Hall, 17th & Arendell St. Please pre-register. Contact *Art Sylvester KC4QD, 613 North Forty Rd., Moorehead City NC 28557-3075.*

MARCH 19-20

MIDLAND, TX Midland ARC will hold their annual St. Patrick's Day Swapfest at the Midland County Exhibit Bldg., Sat. from 9 AM-5 PM, and Sun. from 8 AM-2:30 PM. VE Exams at 12 PM on Sat. Contact *AA5RS* or *N5TQU* via *M.A.R.C., P.O. Box 4401, Midland TX 79704.*

MARCH 20

MILTON FREEWATER, OR The 48th annual W7DP Swapfest, sponsored by the Walla Walla Valley ARC, will be held from 8 AM-3:30 PM at the Milton Freewater Community Center bldg. Talk-in on 147.280. Contact *David L. Pence KB7WRT, 810 E. Sumach St., Walla Walla WA 99362-1348. Tel. (509) 525-2529.*

STERLING, IL The Sterling-Rock Falls ARS 34th annual Hamfest will be held at the Sterling High School Field House, 1608 4th Ave. Talk-in on 146.25/146.85 W9MEP Rptr. Contact *Lloyd Sherman KB9APW, P.O. Box 521, Sterling IL 61081. Tel. (815) 336-2434.*

MARCH 26

MICHIGAN CITY, IN Visit Rogers H.S., Pahs Rd. between Woodland Ave. and Johnson Rd., to enjoy a Hamfest being presented by the Michigan City ARC, between 8 AM-2 PM (Set-up 6:30 AM). Talk-in: 146.49 simplex or 146.37/.97 Rptr. (131.8 Hz PL). VE Exams. Contact *Gene Ward KD9VB, 312 Ash Parkway, Westville IN 46391. Tel. (219) 785-4295.*

UPPER SADDLE RIVER, NJ The Chestnut Ridge Radio Club will sponsor its annual Flea Market from 8:30 AM-2 PM, at the Education Bldg., Saddle River Reformed Church, East Saddle River Road, corner Weiss Road. Talk-in on 146.955 Rptr. Contact *Chestnut Ridge Radio Club Inc., Box 110, Teaneck NJ 07666.*

SPECIAL EVENT STATIONS

FEB 4-6

EUGENE, OR The 1994 Vermont QSO Party will take place the first weekend of Feb., from 7 PM Fri.-12 midnight EST Sat., and from 0000 UTC Sat.-0500 UTC Sun. All licensed Amateur Radio Operators are invited to participate. The Central Vermont ARC (W1BD) and any other legitimate Vermont AR Club will be multipliers for this event. Logs must be postmarked no later than March 1st. Contact *Central Vermont ARC, Vermont QSO Party, P.O. Box 674, Montpelier VT 05602.*

FEB 12-13

EUGENE, OR A CW QSO Party will be held by the Quarter Century Wireless Assoc. Inc. from 0000 UTC Sat.-2400 UTC Sun. Frequencies: 30 kHz inside the CW bands. Regular call signs will be used for all contacts. Send logs to *Bob Reed WB2DIN, 597 Brewers Bridge Rd., Jackson NJ 08527.* For more info, contact *Bill Miller K2GCE, Activities Manager, 217 Porterfield Pl., Freeport NY 11520.*

EVANSTON, WY The Uinta County ARC will operate NW7H 1500Z-2400Z to celebrate the Chinese New Year. Phone 10X on 28.395, 24.945, 21.325, 18.140, 14.245. For a certificate, send QSL with a 9x12 SASE to *Vrunish, P.O. Box 2048, Evanston WY 82931-2048.*

FEB 12-14

CLAREMONT, NH The 1994 New Hampshire QSO Party, sponsored by the NH ARA, will take place on Feb. 12th from 1900 UTC-0700 UTC: Feb. 13th, from 1400 UTC-0200 UTC Feb. 14th. Open to all classes. Techs w/o HF priviledges are invited to join on simplex above 50 MHz. Operating frequencies: CW—1810, 3535, 7035, 14035, 21035, 28035. SSB—1875, 3935, 7235, 14280, 21380, 28320, 50115, 144205. FM—29.610, 52.540, 146.550, 223.500, 446.000, 902.100, 1296.100. There will be a 75 meter phone finale Sun. on 3950 +/- QRM. Logs must be postmarked by March 31, 1994. Contact *Conrad Ekstrom WB1GXM, P.O. Box 1076, Claremont NH 03743-1076.* Please send SASE.

FEB 18-20

MARQUETTE, MI The Hiawatha ARA will operate N8GBA 1700Z Feb. 18th-1700Z Feb. 20th, to honor the Up 200 Sled Dog Championship. The Lower end of the 10, 15, 20 and 40 meter phone bands will be used. For a certificate, send a large SASE with 2 stamps to *Richard Schwenke N8GBA, 21 Smith Lane, Marquette MI 49855.*

FEB 19-20

MOUNT VERNON, VA The Mount Vernon ARC will operate Station N4BV during the hours of 1600Z-2000Z on 19-20 Feb., to commemorate George Washington's birthday. Operations will take place from George Washington's home. Frequencies: The lower General 80m-15m subbands, and on the Novice 10m subband. For a certificate, send QSL with a 9x10 #10 SASE to *Steve Schneider WB4EEA, 8602 Cushman Place, Alexandria VA 22308.*

MARCH 12-13

EUGENE, OR The Quarter Century Wireless Assn. will hold their QCWA phone QSO Party from 0000 UTC-24000 UTC. Operation will start at 30 kHz inside the General phone band. The WARC frequencies will not be used. Regular callsigns will be used for all contacts. Send logs to *Bob Reed WB2DIN, 597 Brewers Bridge Rd., Jackson NJ 08527.* For info contact *Bill Miller, K2GCE Activities Manager, 217 Porterfield Pl., Freeport NY 11520.*

MARCH 13-14

MILWAUKEE, WI The West Allis RAC will sponsor the 1994 Wisconsin QSO Party from 1800Z Mar. 13th-0100Z Mar. 14th, for CW and phone. Mail logs by March 31st. For details, contact *WARAC, P.O. Box 1072, Milwaukee WI 53201.*

MARCH 20

PISCATAWAY, NJ Member stations of the Piscataway ARC will operate their stations, signing /VOA, from 0000Z-2400Z, to commemorate the World War II operation of the Voice of America relay station WB0U, in the Bound Brook section of Piscataway. Frequencies: CW—All Novice bands; Phone—Lower 1/3 of General 75-15m bands, and the Novice 10m band. For a certificate, send QSL and 9x12 SASE to the call book address of the station worked.

Uncle Wayne's Bookshelf

BOOKS FOR BEGINNERS

02D42 **Digital Novice** *by Jim Grubbs* Geared to make you a more knowledgable participant. **$8.50**

01A87 **Shortwave Listener's Antenna Handbook** Primer antenna theory. **$13.95**

05C25 **Basic A.C. Circuits** A step-by-step approach for the beginning student. **$24.50**

20N018 **Technician Class License Manual: New No-Code** *by Gordon West* This book covers everything you need to become a Technician Class Ham. Every question and answer on the examinations is found in this one book. FCC Form 610 application. **$9.95**

20N092 **The Wonderful World of Ham Radio** *by Richard Skolnik, KB4LCS* Simple. clear, and fun. Introduces young people to amateur radio. **$7.95**

20N100 **Electronics Build and Learn (2nd Ed.)** *by RA Penfold* Combines theory and practice so that you can "learn by doing." **$12.50**

20N099 **Digital Electronics Projects for Beginners** *by Owen Bishop* Contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment. **$12.50**

AR2871 **W1FB's Help for New Hams** *by Doug DeMaw W1FB* Complete for the newcomer. Put together a station and get on the air. **$10.00**

AR2286 **First Steps in Radio** *by Doug DeMaw W1FB* Series of *QST* articles. **$5.00**

SHORTWAVE

06S57 **1993 Passport to World Band Radio** *by International Broadcasting Services, Ltd* You'll get the latest station and time grids. **$16.50**

03S11 **Shortwave Receivers Past and Present** *edited by Fred J. Osterman* Guide to 200+ shortwave receivers manufactured in the last 20 years. The Blue Book of shortwave radio value. **$8.95**

07R25 **The RTTY Listener** *by Fred Osterman* New and expanded. This specialized book compiles issues 1 through 25 of the *RTTY Listener Newsletter.* Contains up-to-date. hard-to-find information on advanced RTTY and FAX monitoring techniques and frequencies. **$19.95**

03C09 **Shortwave Clandestine Confidential** *by Garry L. Dexter* Covers all clandestine broadcasting. country-by-country: tells frequencies, other unpublished information: spy. insurgents, freedom fighters, rebel, anarchist radio, secret radio. **$8.50**

03M221 **US Military Communications (Part 1)** US Military communication channels on shortwave. Covers frequencies. background on point-to-point frequencies for the Philippines, Japan and Korea, Indian and Pacific Oceans, and more. **$12.95**

03M222 **US Military Communications (Part2)** Covers US Coast Guard, NASA, CAP, FAA, Dept. of Energy, Federal Emergency Management Agency, Disaster Communications, FCC, Dept. of Justice. From 14 KC to 9073 KC. **$12.95**

03M223 **US Military Communications (Part 3)** Completes the vast overall frequency list of US Military services. from 8993 KC to 27,944 KC. **$12.95**

09S42 **The Scanner Listener's Handbook** *by Edward Soomre N2BFF* Get the most out of your scanner radio. **$14.95**

11T88 **Tune in on Telephone Calls** *by Tom Kneitel K2AES* Formatted as a frequency list with detailed description of each service and its location in RF spectrum. **$12.95**

03K205 **Guide to Radioteletype (RTTY) Stations** *by J. Klingenfuss* Updated book covers all RTTY stations from 3MHz-30MHz. Press, Military, Commercial, Meteo. PTTs, embassies, and more. **$12.95**

11AS10 **Air Scan Guide to Aeronautical Communications (5th Ed.)** *by Tom Kneitel K2AES* Most comprehensive guide to monitoring US aeronautical communications. Covers all Canadian land airports and seaplane bases. plus listings for Central America, the Caribbean, North Atlantic, and the Pacific Territories. **$14.95**

15A002 **Scanner and Shortwave Answer Book** *by Bob Grove* Most frequently asked questions by hobbyists. **$13.95**

07A66 **Aeronautical Communications Handbook** *by Robert E. Evans* Exhaustive. scholarly treatment of shortwave aeronautical listening. **$19.95**

11RF13 **The "Top Secret" Registry of US Government Radio Frequencies (7th Ed.)** *by Tom Kneitel K2AES* This scanner directory has become the standard reference source for frequency and other important information relating to the communications of federal agencies. **$19.95**

11F52 **Ferrell's Confidential Frequency List, New Revised Edition** *compiled by A.G. Halligey* All frequencies from 4 MHz-28MHz covering ship, embassy, areo. Volmet. Interpol. numbers. Air Force One/Two, more. **$19.50**

11SR97 **National Directory of Survival Radio Frequencies** *by Tom Kneitel K2AES* Handy and concise reference guide to high interest communications frequencies required by survivalists. **$6.95**

11SM11 **Scanner Modification Handbook, Vol. 1** *by Bill Creek* provides straightforward step-by-step instructions for expanding the operating capabilities of VHF scanners. **$17.95**

11EE06 **Guide to Embassy Espionage Communications** *by Tom Kneitel K2AES* Candid and probing examination of worldwide embassy and (alleged) espionage communications systems and networks. **$10.95**

20N094 **A Flick of the Switch, 1930-1950** *by Morgan E. McMahon* Discover the fast-growing hobby of radio collecting. **$8.95**

07R26 **World Wide Aeronautical Communications** *by Robert E. Evans* Aircraft/Air Traffic Control, Aircraft/Company Operations, Aviation Weather Broadcasts, Aeronautical Flight Tests, Worldwide Military Air Forces, Aero Search & Rescue. Aero Law Enforcement. NASA Flight Support, Aero Terms & Abbreviations and Aero Tactical Identifiers. **$6.95**

11T89 **Scanner Modification Handbook Vol. 2** *by Bill Creek* Here it is—a companion to Vol. I. In fact, Vol. 2 has a section that provides improved approaches and updated techniques for the mods in Vol. 1. There's 18 new exciting modifications for popular scanners. **$17.95**

03R01 **World Press Services Frequencies (RTTY) New 5th Ed** A comprehensive manual covering radioteletype news monitoring—contains all information—antenna. receiving, terminal units, plus three extensive frequency lists. **$8.95**

ARRL BOOKS

AR1994 **ARRL 1994 Handbook (71st Ed.)** Features: added DSP, improved treatment of Pi and Pi-L. all new all-digital-logic, plus lots more. **$25.00**

AR1993 **ARRL 1993 Handbook (70th Ed.)** 39 chapters, featuring 2,100 tables, figures and charts. Comprehensive, well organized and affordable. **$25.00**

AR1086-4 **ARRL Operating Manual (4th Ed.)** Information on how to make the best use of your station. including: interfacing home computers. OSCAR, VHF-UHF. **$18.00**

AR0194 **Antenna Compendium Vol. 1** Materials on verticals. quads. loops. yagis. reduced size antennas, baluns, Smith Charts, antenna polarization. **$10.00**

AR2545 **Antenna Compendium Vol. 2** Covers verticals. yagis. quads. multiband and broadband systems. antenna selection. **$12.00**

AR4017 **Antenna Compendium Vol. 3** More verticals, yagis, quads, plus loops. arrays, mobile, direction finding, controlled currents, computerized, installation. overloads, plus 40 new articles for beginner's to advanced. **$14.00**

AR2626 **Companion Software for Antenna Compendium Vol. 2** 5 1/4" MS-DOS floppy. **$10.00**

AR0488 **W1FB's Antenna Notebook** *by Doug DeMaw W1FB* Get the best performance out of unobtrusive wire antennas and verticals. Build tuners and SWR bridges. **$9.50**

AR0348 **QRP Notebook** *by Doug DeMaw W1FB* Presents construction projects for the QRP operator. **$9.50**

AR4141 **W1FB's Design Notebook** *by Doug DeMaw W1FB* Filled with simple practical projects that can be built using readily available components and common hand tools. **$10.00**

AR2200 **Antenna Impedance Matching** *by Wilfred N. Caron* Most comprehensive book written on using Smith Charts in solving impedance matching problems. **$20.00**

AR0402 **Solid State Design** Good, basic information, circuit designs and applications; descriptions of receivers, transmitters, power supplies, and test equipment. **$12.00**

AR3193 **Weather Satellite Handbook (4th Ed.)** *by Dr. Ralph Taggart WB8DQT* Expanded and revised to reflect today's weather-fax satellite technology. **$20.00**

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Lanze Code Programs—(Available on 5 1/4" disk.) Inexpensive complete study guide code programs for both the C64/128 Commodores and the IBM compatibles. Programs include updated FCC questions, multiple choice answers, formulas. schematic symbols. diagrams, and simulated (VE) sample test.

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IBM06, COM06 IBM/Commodore Tech No Code—Lanze Code Program Contains all the authorized FCC questions and answers used in testing formats. schematic symbols. diagrams. and sample test for passing the new Technician No Code license. **$24.95**

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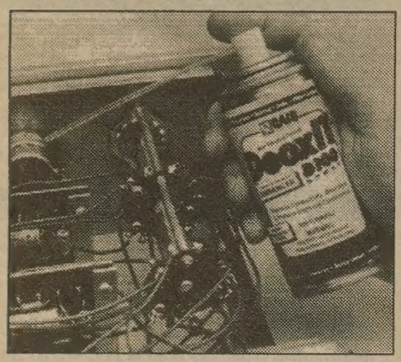


CAIG LABORATORIES INC.

Caig has introduced an environmentally-safe aerosol for its DeoxIT product. DeoxIT's active ingredients are formulated to deoxidize, clean, preserve, lubricate, and improve conductivity on metal connectors and contacts without the need for carrier solvents for dilution or cleaning surfaces. The spray container provides short bursts of 100% concentrate of DeoxIT via a precision-metered valve.

Pretreating with DeoxIT will reduce intermittent connection problems, increase transmission quality, and improve reliability. The product is ideal for use on switches, relays, batteries, connectors, terminal strips, interconnecting cables, and other metal surfaces.

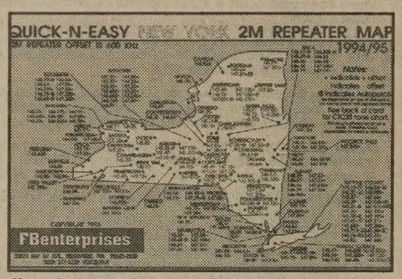
For more information contact *Caig Laboratories, Inc., 16744 West Bernardo Drive, San Diego, CA 92127; (619) 451-1799, Fax (619) 451-2799.* Or circle Reader Service No. 201

FB ENTERPRISES

FB Enterprises is now offering the 1994/95 edition of their popular "Repeater Maps." These maps are available for all US states, Canadian provinces, Central American countries, and Caribbean islands. (California is split into Northern and Southern California, so please specify when ordering.)

The updated maps show 2 meter repeaters in full color on the front of the card, and the bands between 220 MHz and 1.2 GHz are in black and white on the back. They include autopatch information and CTCSS tones for those repeaters which use them.

The maps are 5-1/2" x 8-1/2" and are laminated in clear plastic. They retail for $3.95 and are available at your ham radio dealer or



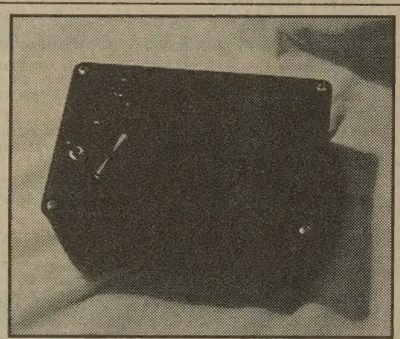
directly by mail order. Catalogs are available for $2 (refunded with purchase). For more information contact *FB Enterprises, 23801 NW 1st Ave., Ridgefield, WA 98642-8830; Voice/Fax (800) 377-2339.* Or circle Reader Service No. 207.

MICRO-OHM MEASUREMENTS

Micro-Ohm Measurements has announced the new "Little ELF" portable Extremely Low Frequency detector. The Little ELF responds to less than one milligauss of electromagnetic energy radiated from microwave ovens; TVs, cellular phones, computer screens, power supplies, and a host of items around the house and hamshack.

Don't take chances! Be aware of where you can sit, stand, and work beyond the area of 10 to 250 Hz emissions, especially in the 60 Hz range. There is an elevated concern regarding this very controversial issue. Prudent avoidance has been suggested by the Environmental Protection Agency.

The Little ELF permits detection of these crucial and potentially hazardous generators by sounding a "sonalert" in proportion to the intensity of the energy source. This unit is hand-held and is merely pointed at the sus-



pected source. It operates from two 9V batteries (not included). The introductory price is $49.50 ppd.

For more information contact *Micro Ohm Measurements, P.O. Box 460, Brookshire, TX 77423; (713) 934-4659. Or circle Reader Service No. 208.*

HAMBREW

Hambrew, a new magazine devoted to amateur radio builders and designers, is now being published quarterly for hams around the world. The focus ranges from beginner-level kit building to more advanced RF design, with some theory sprinkled in. Articles in the inaugural Autumn 1993 issue included a Ramsey 30 meter transmitter review, constructing foam-core panel cases and cabinets, the NorthWest QRP 30-30 Transmitter, and decoupling loops for dipoles, with a discussion of counterpoise.

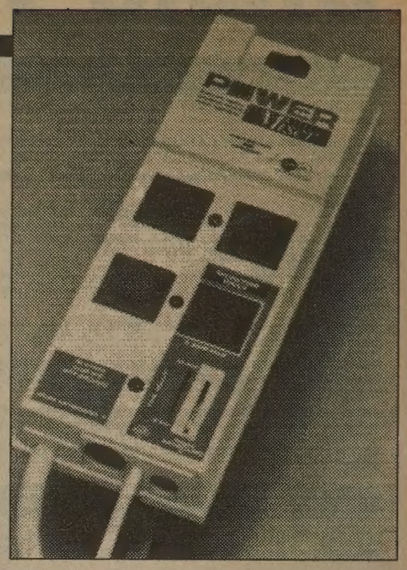
Classified ads are free to both commercial and non-commercial subscribers. Subscriptions are $20/yr. domestic, $30/yr. Canada and Mexico, and $35/yr. elsewhere. For more information contact *Hambrew, P.O. Box 260083, Lakewood, CO 80226-0083; (800) 5-HAMRIG.* Or circle Reader Service No. 205.

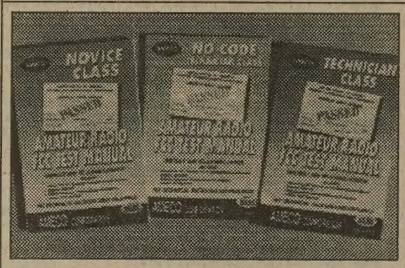
TRIPP LITE

Tripp Lite has introduced a new product that is perfect for ham shacks equipped with PCs and PC clones. The new Power Miser combination screen monitor and surge suppressor saves electricity by automatically turning off power-hungry computer monitors. Keyboard activity instantly restores the monitor to its prior screen.

The Power Miser is also a high-quality four-outlet surge suppressor with superior spike and noise line filtering for connected equipment. It provides 720 joules of surge suppression and excellent RFI and EMI noise rejection.

The Power Miser has a retail price of $99.95 and can provide savings of up to $190 a year. For further information contact *Tripp Lite, 500 N. Orleans, Chicago, IL 60610-4188; (312) 329-1777, Fax (312) 644-6505.* Or circle Reader Service No. 203.





AMECO CORPORATION

All the latest changes in FCC amateur radio test preparation requirements are incorporated into the new, revised editions of Ameco's popular license manuals. Separate manuals are available for the Novice Class (Cat. #27-01), the Technician Class (Cat. #28-01), and the new No-Code Technician Class (Cat. #78-01).

Each book covers all the FCC examination questions for each class, with corresponding multiple-choice answers. There is a clear, concise explanation for each correct answer, which helps the reader fully understand the theory and concept behind the question. All questions and answers are conveniently arranged to minimize flipping pages.

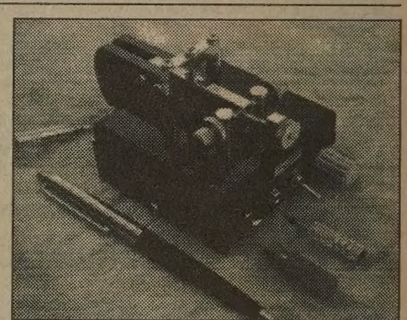
These books are by Mr. Martin Schwartz, who has over 40 years experience writing amateur radio license instruction materials. You can purchase the Ameco books from your local ham radio dealer, or contact *Ameco Corporation, 224 East Second Street, Mineola, NY 11501; (516) 741-5030, Fax (516) 741-5031. Or circle Reader Service No. 206.*

G4ZPY PADDLE KEYS INTERNATIONAL

The first commercially produced single-lever combo keyer has been introduced by G4ZPY Paddle Keys International. This new beauty has a little something extra—if you get tired of using the single lever and want to switch over to a twin lever, there is a jack socket fitted to enable another keyer to use the same iambic electronic keyer.

The new combo may be purchased in four different finishes, and all are fitted with key-down switches. This brings the G4ZPY collection to 50 keyers—the largest selection in the world!

All keyers are handcrafted, so they take longer to produce. For more information, send



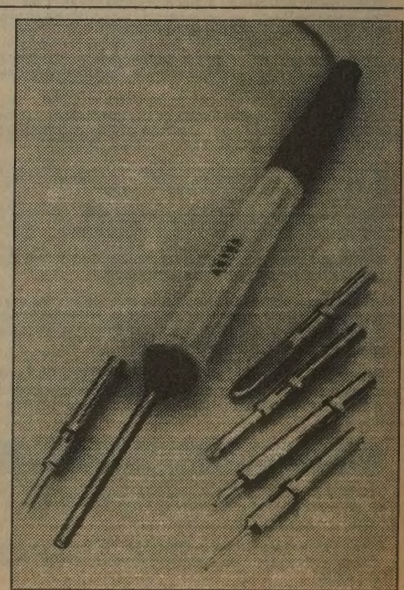
an SASE (UK) or two IRCs to *G4ZPY, 41 Mill Dam Lane, Burscough, Ormskirk, Lancs., England L40 7TG; Tel/Fax 44 (0) 704 894299.* Or circle Reader Service No. 202.

M.M. NEWMAN CORPORATION

A high efficiency miniature soldering iron that accommodates a wide variety of slide-on tips, including a hot knife tip, is now available from M.M. Newman Corporation. The Antex Model C Soldering Iron features a pencil-thin handle for precision control and is designed with the heating element directly under the tip for optimum thermal efficiency.

Tips available for the Antex Model C include a conventional spade, chisel, stubby, needle, pyramid, cone, and the hot knife. Tips are constructed with a special copper alloy for rapid heat up and recovery, and are nickel-plated for easy wetting. The iron reaches 700 degrees F in just 45 seconds.

The list price is $19.95 and includes a standard tip. Replacement tips are priced from $1.55 each. A catalog is available upon request. For more information contact *M.M. Newman Corporation, 24 Tioga Way, P.O. Box 615, Marblehead, MA 01945; (617) 631-7100, FAX (617) 631-8887.* Or circle Reader Service No. 204.



FT-2200/7200
2-m/70-cm Mobiles

- **Frequency Coverage:**
  FT-2200
  RX: 110-180 MHz
  TX: 144-148 MHz
  FT-7200
  RX/TX: 430-450 MHz
- 50 Memory Channels
- Wide Receiver Coverage: 110-180 MHz
- AM "Aircraft" Receive: 110-139 MHz
- Built-In DTMF Paging/Coded Squelch
- Power Output 50/25/5 Watts
- CTCSS Encode Built-In
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- Optional Digital Voice Storage System
- Backlit DTMF Mic
- **Accessories:**

FTS-27	CTCSS Decode Unit
DVS-3	Digital Voice System Unit
MW-2	Remote Control/ Wireless Mic
SP-7	External Speaker

"The FT-2200 answers my problem! It fits anywhere, and the 3 power levels are great!"

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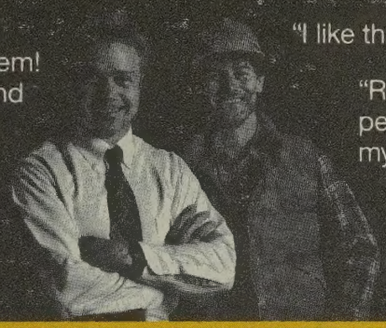

"I like the FT-2400H!"

"Rugged performance is my answer!"

For your sleek compact car, the sculptured FT-2200 looks terrific. With leading-edge features, performance and reliability too, it's the perfect answer to your 2-m needs.

At 5.5"W x 1.6"H x 6.5"D the FT-2200 installs nearly anywhere. And, it does "lead" with features like optional Remote Control Wireless Mic – first in the world for any 2-m mobile and AM Aircraft Receive – first in a Yaesu mobile. Performance? The FT-2200 has more than twice the memories of the competition! Reliability? Its bright, new LCD display and backlit DTMF Mic makes night mobiling safe. Features, performance, reliability – in a powerful little package. See your dealer for *this* answer to your 2-m needs.

The Yaesu FT-2400H set the standard by which all 2-m mobiles are judged. The first and only amateur radio to pass rugged MIL STD 810D tests for shock and vibration, its one-piece die-cast chassis with extra large heat sink gives years of trouble-free operation.

With 50 watts of TX power, large alpha-numeric display, auto display dimmer, exclusive backlit DTMF Mic and advanced track tuning front end for superior receiver performance, the popular FT-2400H is the choice of amateurs in the know.

Features, performance, reliability – ready to go anyplace. See your dealer for *this* answer to your 2-m needs.

FT-2400/7400H
2-m/70-cm Mobiles

- **Frequency Coverage:**
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  RX: 140-174 MHz
  TX: 144-148 MHz
  FT-7400H
  RX/TX: 430-450 MHz
- Rugged Mil-Spec Design
- Advanced Track Tuning (ATT)
- 31 Memory Channels
- Wide Receiver Coverage: 140-174 MHz
- Selectable Alpha-Numeric Display
- Largest 2-Meter Display Available
- CTCSS Encode Built-In
- Power Output 50/25/5 Watts
- Flip Up Front Control Panel Hides Seldom Used Buttons
- Backlit DTMF Mic
- **Accessories:**

FTS-17A	CTCSS Decode Unit
FRG-6	DTMF Paging Unit
SP-4	External Speaker
FP-700	Power Supply

NEW

Yaesu answers your 2-m mobile needs.

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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144 MHz/450 MHz single band HTs

More Power !

Features

- 3-watt output from MOS FET power module and supplied 6-volt battery (TH-22AT: approx. 3 watts, TH-42AT: approx. 2.5 watts), and 5-watt output with optional PB-34!
- Compact design: 2-3/16 x 4-5/8 x 1 in.
- Built-in DTMF keypad with monitor
- Built-in DTSS page system ■ Large 1-7/16" speaker
- 41 E²PROM channel memories (including 1 call channel)
- Multiple scan functions (VFO, call & memory)
- Carrier-operated & time-operated scan stop modes
- Tone alert with elapsed time indicator
- Battery-saver circuit and auto power-off function to extend battery life ■ Selectable squelch configuration
- RF output power control (Hi/Low/EL)
- Built-in CTCSS encoder, optional TSU-8 decoder (any tone can be stored in any channel)
- User-friendly menu system to customize your operating preferences ■ Easy to program and use
- Modifiable for MARS and CAP. Specifications guaranteed for Amateur bands only. Permits required for MARS and CAP use.
- Wide range of accessories to enhance operating convenience and enjoyment

Slim, compact, lightweight. These words describe the exterior of the new TH-22AT Series HTs. Rugged, innovative, sturdy. These words describe what is on the inside. Because along with the beauty, this new series of HT has all the things you want in a portable communications package. Like a streamlined, easy to program interface, one touch controls, and a simplified menu of functions that you can customize to suit your needs. Even a DTMF memory that stores five of your favorite 15 - digit telephone numbers for autopatch use. Wide band receive - 136 to 173.99 MHz. A new innovative microprocessor and final amplifier circuit enables a full five watts, while conserving battery power. (The supplied battery provides **3 watts**.) Easy mobile operation with optional PG-3H cable.

As always, a full line of accessories is available to enhance your operating enjoyment!

See your favorite Authorized Kenwood Amateur Radio Dealer for all the details!

Modifiable for MARS/CAP use. Permits required. Specifications guaranteed for Amateur band only.

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